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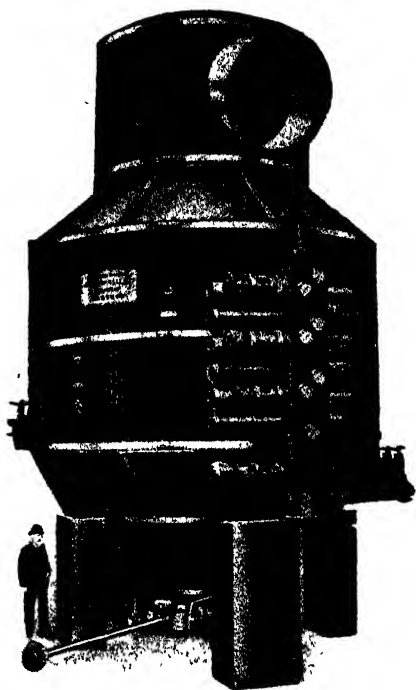
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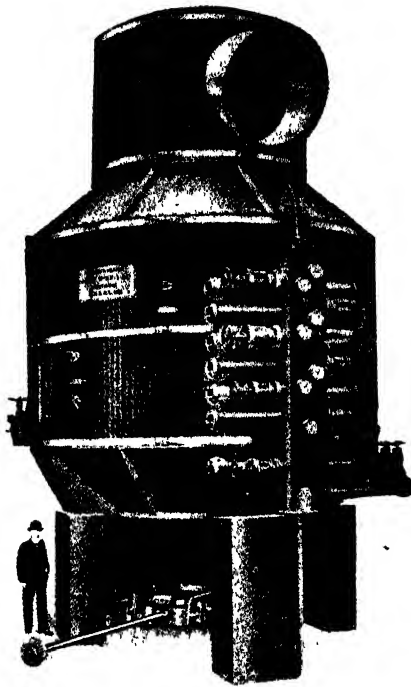
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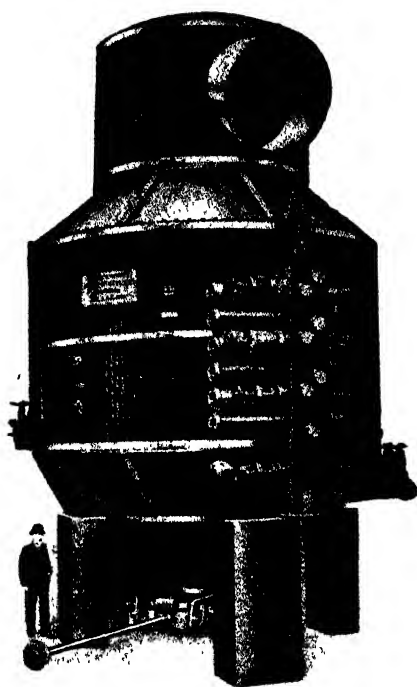
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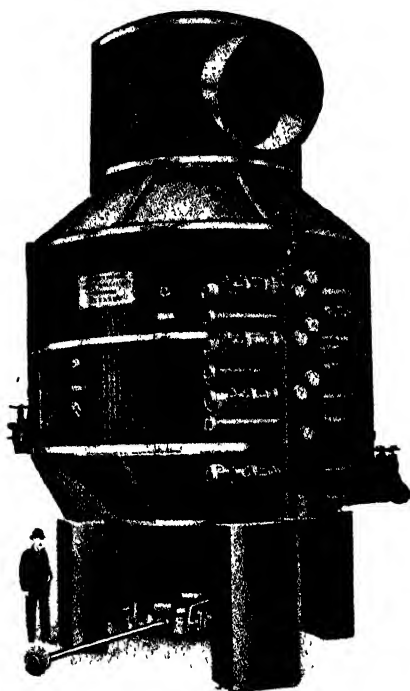
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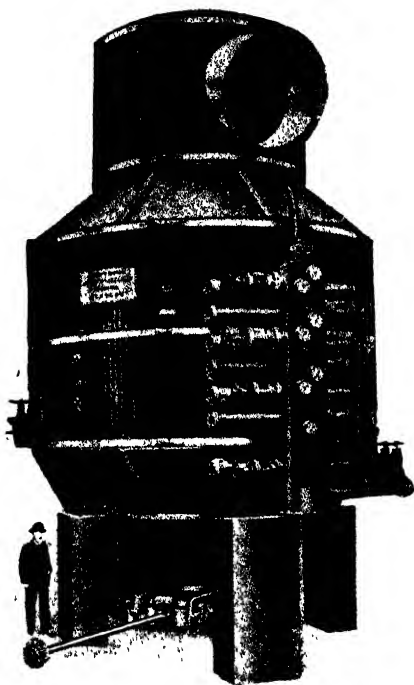
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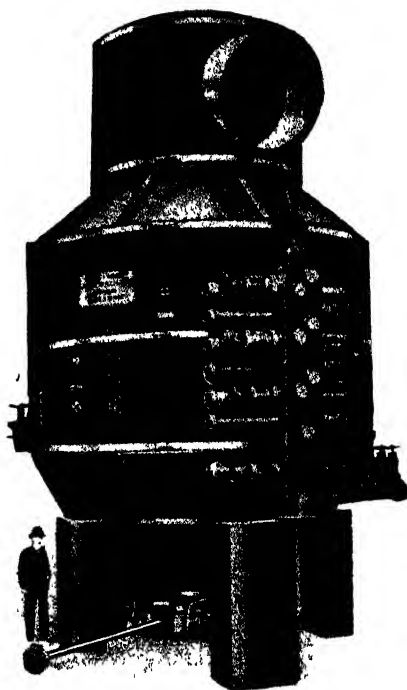
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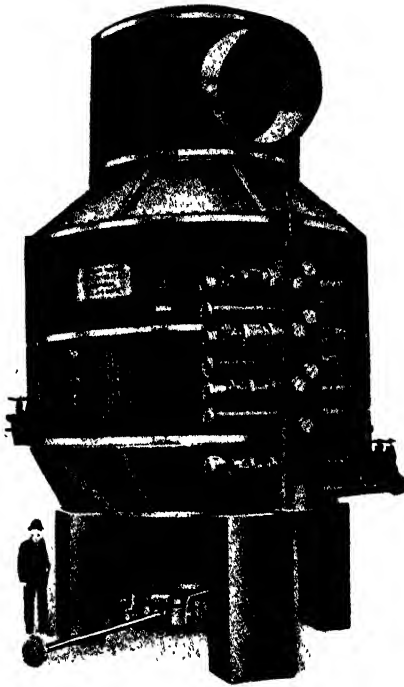
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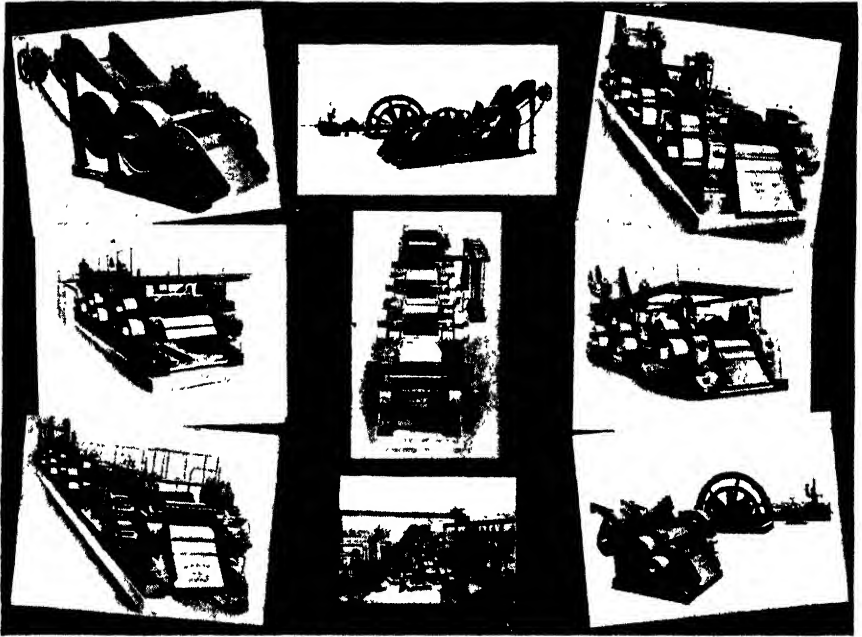
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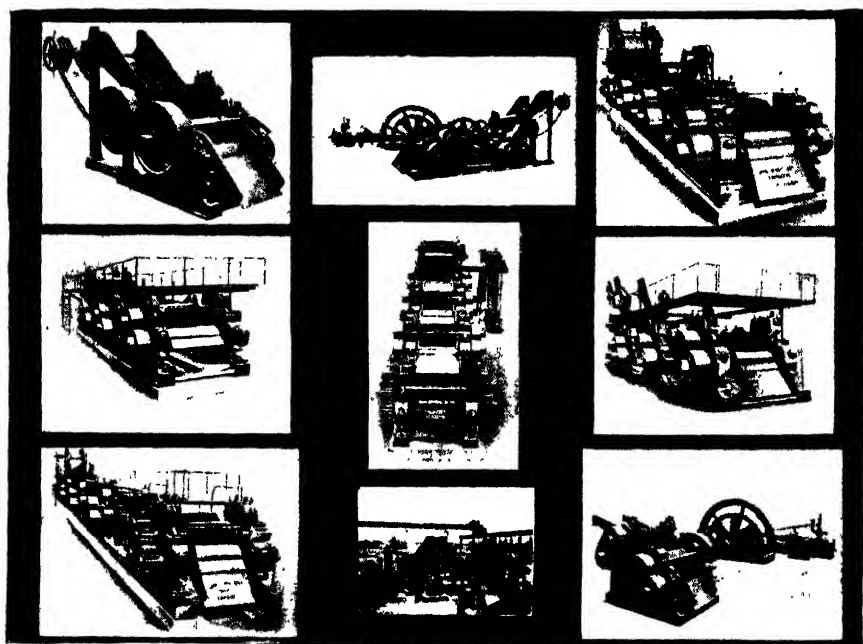
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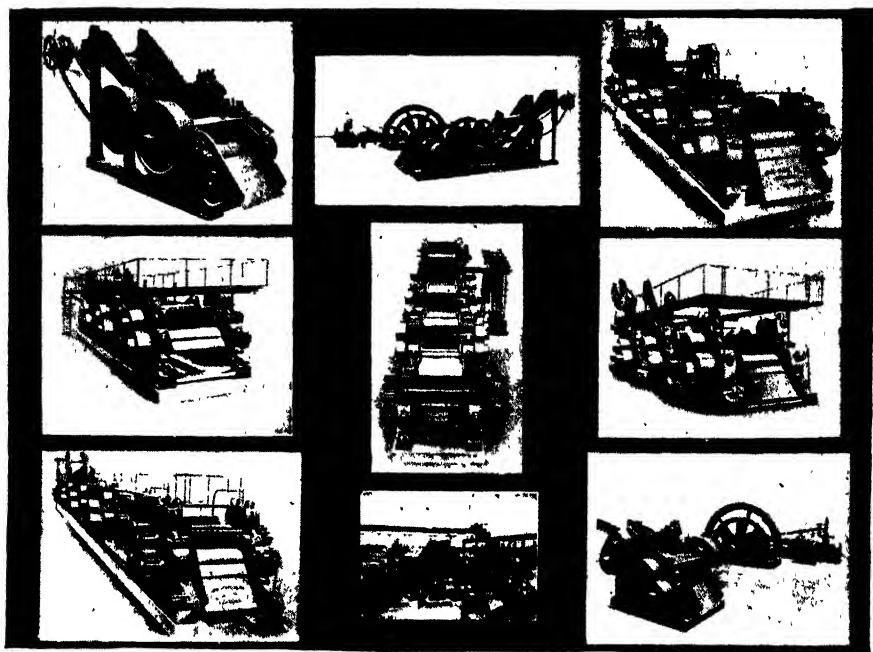
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McNEIL MACHINERY.



Extract from Philippines "SUGAR CENTRAL AND PLANTERS' NEWS," of May, 1921

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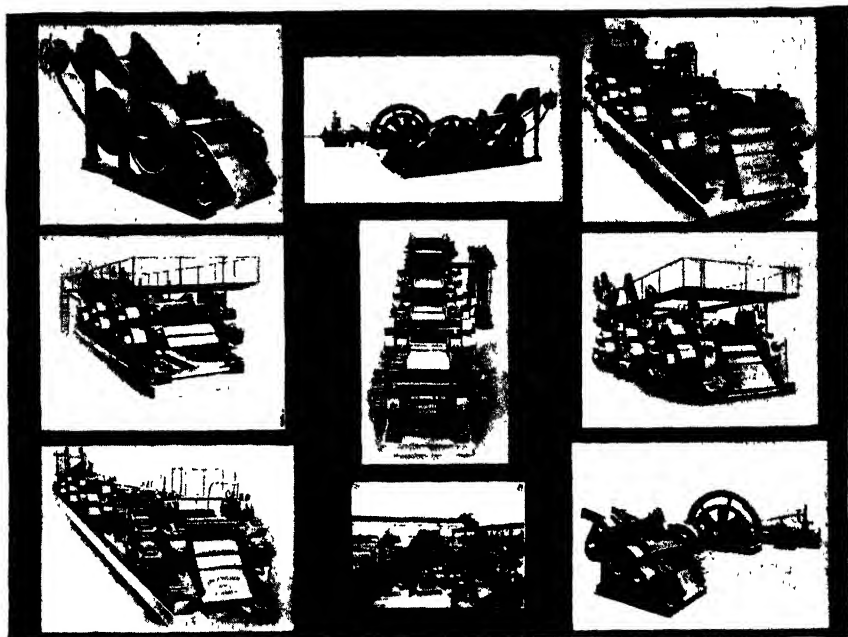
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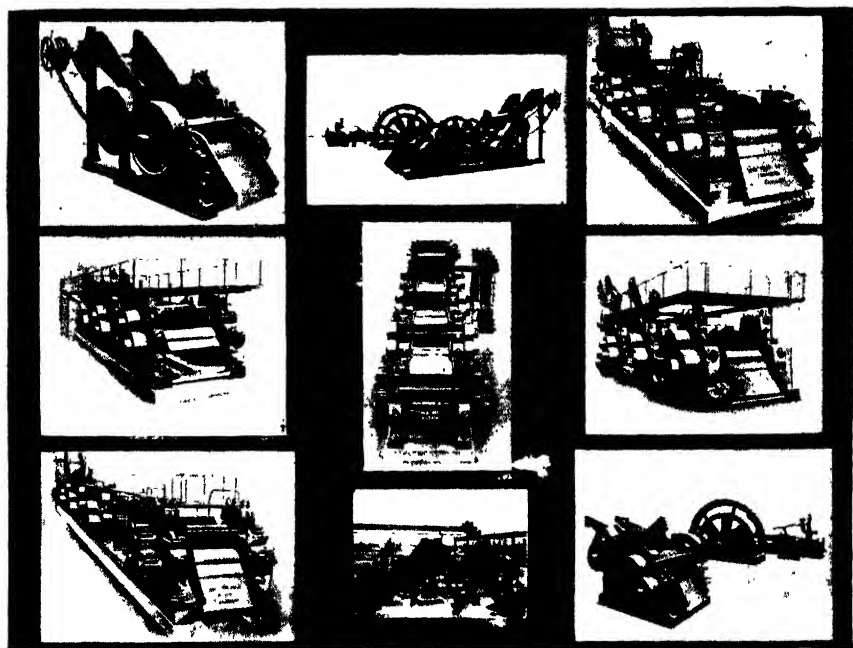
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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Royal Commission's Tenure of Office.

As we were disposed to think last month, it was a trifle premature to assume, as the general press did, that the operations of the Royal Commission on the Sugar Supply were to be terminated almost immediately. The Government have had six weeks wherein to consider the matter, and at the time of writing have announced no decision even if they have come to one. At the same time it is reported that the Royal Commission have ceased to buy sugar, so it is not unlikely that the decontrol of sugar will be completed during the next three months. In view of the fact that the Ministry of Food goes out of office at the end of March and hands over its few remaining duties to the Board of Trade, it is quite possible that that date also will see the winding up of the Royal Commission's activities.

Sugar Prices Reduced in United Kingdom.

Meanwhile they have continued their task of gradually cheapening the price of sugar and following on the reduction of 8s. in the wholesale price which took place on December 28th, the retail price of sugar was reduced by 1d. per lb. on January 3rd and now stands at 9½d. for castor, 9½d. for cubes and loaf sugar, and 9d. for granulated. A further slight reduction may be feasible some time during 1921; but in view of the high cost of bringing the sugar from the foreign factory to the grocer's counter, a cost which was not long since officially put at 4d. or 5d. per lb. (including the duty of virtually 2½d. per lb. for raws), it is difficult to see how any further appreciable reduction can be looked for till production has once more overtaken consumption. When that moment arrives, then the natural price of sugar will be based on the cost of production *plus* the cost of transport, and in view of the fact that both these costs have risen probably for good, it is difficult to imagine that the price of sugar in the future will average much if anything below 6d. per lb. in this country. True, keen competition may lower prices for a time, but unremunerative prices inevitably involve a subsequently reduced production with the natural result that scarcity returns and prices go up once more. This law of sugar prices was one that the late Mr. GEORGE MARTINEAU preached, in season and out, in the pages of this journal, particularly in connexion with the

evil influence of sugar bounties in alternately stimulating production and then discouraging it, as a consequence of which an era of artificially low prices was generally followed by an era of high ones. It is to be hoped that the future will see a minimum of those violent fluctuations that have characterized past prices: but till we are less dependent on two such large sources of supply as Cuba and Java, there is always a risk that the failure through drought, disease, or other cause of a particular crop in one of these islands may excessively affect the market. The remedy is to extend the sources of supply as much as possible, and in different parts of the Empire as well as in foreign regions a considerable effort is now being made to extend the sugar industry, though it is hardly to be expected that any rapid progress will be chronicled; numerous difficulties have to be faced, not the least of which is the growing scarcity of capital in this country. We believe that progress will be made, but it is useless to expect it on anything like the scale which up to three years ago characterized the expansion of the sugar industry in Cuba, where American money was poured out like water, and with very remunerative results as a whole.

The Supposed Profits of the Royal Commission's Trading.

In their anxiety to discover a fresh stick wherewith to beat the Royal Commission for the Sugar Supply, certain organs of the daily press in this country have discovered a mare's nest. At the outset we may remark that the Government departments concerned with the preparation of trading accounts are greatly to blame for this misdirected energy, for they have lately issued from the Treasury a White paper (*Cmd. 10612*) containing *inter alia* the Profit and Loss account of the Royal Commission's trading to March, 1919, and showing a net profit of over six millions sterling—issued it without a single note of explanation; and the press have seized on these figures, forgetting altogether that this is old news, and that the financial transactions of the Royal Commission to the date in question were published by the Select Committee on National Expenditure last May when the six millions odd profit was admitted. But the important explanation was then and there made that for the year ending March, 1920, sales of sugar were made to the public at a price which wiped out four millions of the previous trading balance. "The operations [they wrote] for the year 1919-20 have, therefore, involved an estimated loss of about £4,000,000 for that one year alone."¹ What is more, we believe that since last March the remaining two millions have been virtually wiped out, and it is quite possible that when the final balance sheet of the Royal Commission is published (we suppose some time in 1922), it will be as likely to show a net loss as to reveal any profits. Whatever the faults of the Royal Commission, especially in their first year of operations, they can hardly be accused of profiteering.

Development in Cuba.

According to a report of an American Consul in Cuba, there is considerable activity in the development of the Antilla district of Cuba, and it is calculated that during the next two years a sum of nearly \$34,000,000 will be expended mainly in building up the sugar industry of the district. New sugar centrals are to be built: at Cayo Mambi with a capacity of 50,000 long tons—this is to be run by the Atlantic Fruit Co., which owns the greater part of the cane lands around, and should be ready to grind by March, 1921: at San German, Oriente, where a central—Canarias—is being built with Spanish capital to turn out about 40,000 long tons per crop, a large part of the machinery for this being second-hand: and at

¹ *S. J.*, 1920, 304.

Notes and Comments.

Omaja, Oriente, where the Colorados Sugar Company is erecting a new central with a capacity of over 20,000 tons; the machinery for this is said to be out of a former Louisiana factory, the plant of which has been transferred to Omaja; eventually the capacity may be doubled. Besides the above new mills, large sums are being spent in extending or improving the following American-owned centrals: Baguanos, Chaparra, Delicias, Preston, Banes, Marcané, Manatí, and San Gerónimo. Amongst the items of expenditure contemplated, one observes that several of these centrals are about to convert their locomotives to oil fuel.

Sugar in the Philippines.

P. J. WESTER, of the Philippine Agricultural Service, lately contributed to *Sugar*¹ a paper on sugar cultivation in the Philippine Islands, written with the avowed object of drawing attention to the vast field awaiting American capital for the production of raw materials in the Philippines. He traces the increase in sugar exports from 1910 to 1918, during which period it steadily rose from 152,639 to 396,243 metric tons, and puts this down to modern mills, better cultivation and new varieties, although the latter are allowed to be not yet widely grown. We think that his argument would lose none of its force if he boldly carried his figures back to the time when the United States entered on the scene in 1898. Owing to the various troubles, the exports then suddenly fell from about a level of 200,000 tons to less than half that quantity and sometimes nearer a quarter, and it took till 1911 before the high figure under Spanish rule was again reached. Now, however, the introduction of American capital is undoubtedly having a very marked effect and the islands appear to be on the high road to a great expansion in the sugar industry. We think that the writer is justified in prophesying that this expansion will be much more rapid in the next decade than it has been in the last nine years. We presume, however, that the unhappy state of the sugar industry all over the world at the present time will have its influence here too. Interesting comparisons are drawn between the amount of potential wealth in the three new tropical dependencies of the United States and in Java, and Mr. WESTER strives to show that it will be chiefly to the Philippines that the United States will have to look if she desires to be practically independent of other sources for her requirements of tropical industrial supplies.

Cane Grub Investigations in Queensland.

An interim Report of Dr. ILLINGWORTH on Cane Grub Investigations in Queensland (dated 17th September, 1920) appears to be, as usual, full of interest, and it is clear that good work is being done. The general conditions of the canes continue to be excellent and there is the promise of another maximum crop. The digger wasps are everywhere in evidence in the fields infested with White Grub, and there is thus the promise of a material decrease in this serious pest. The bacterial and fungus diseases of the grub still appear to be active, although their distribution appears only to be local. Owing to the enormous mass of spores from each single infected grub, it is hoped that the ploughing and cultivation of the fields will thoroughly infect the soil and assist materially in fighting the pest. The Borer Beetle, second only to the white grub in importance, appears to be rapidly spreading, especially along the lines of the railways bringing canes to the factories. This pest would, however, appear to be coming under control, because of the marked decrease where the Tachinid parasite bred at the station has been liberated. The Linear Bug, lastly, appears to be rapidly increasing, and at present no method

¹ November, 1920, p. 647.

is suggested of fighting it, save clean cultivation and the removal of all grass from the fields and headlands. Dr. ILLINGWORTH draws an alarming picture of the possibilities of damage by such sucking insects, as taken from the records of the Hawaiian plantations before the frog-hopper was brought under control.

An Imperial Bureau of Mycology.

The Imperial War Conference which met in 1918 unanimously adopted a proposal that a central organization should be established for the encouragement and co-ordination of work throughout the Empire on the diseases of plants caused by fungi in relation to agriculture. The outcome of this resolution is the formation of an Imperial Bureau of Mycology with headquarters at Kew. A strong committee of management has been formed consisting of some of the foremost biologists in the United Kingdom; and Dr. E. J. BUTLER, late Imperial Mycologist and Agricultural Adviser to the Government of India, and Director of the Research Institute at Pusa, has been appointed Director; at Kew he will have the advantage of proximity to the fine library and collections of the Royal Gardens, with the Director and staff of which his Bureau will work in co-operation. Incidentally, Dr. BUTLER who lately retired from his Indian appointments has received, in the New Year's honours, a Companionship of the Indian Empire (C.I.E.), a well-deserved and by no means excessive recognition of his labours for agriculture in India, which included a good deal of work on sugar cane disease.

The funds of the Bureau are entirely provided by contributions from the various self-governing Dominions, India, Egypt and the Sudan, and the non-self-governing Colonies and Protectorates. It will work broadly on the lines of the existing Imperial Bureau of Entomology at South Kensington, and will aim at doing for the other great class of destructive agencies in agriculture, namely, the diseases and blights of plants caused by fungi, what the older Bureau has so successfully done in regard to injurious insects. It will be a central agency for the accumulation and distribution of information and for the identification of specimens sent in from all parts of the Empire. It is proposed to issue, as soon as funds permit, a periodical journal through which those interested in mycological work in regard to agriculture will be kept informed of progress elsewhere. There are at present over fifty officials engaged in this work in the Overseas parts of the Empire, while the number of agriculturists, planters and the like practically interested is legion.

The Department of Overseas Trade.

One outcome of the war for assisting British trade is the Department of Overseas Trade (Development and Intelligence) which is run jointly by the Foreign Office and the Board of Trade. It is ostensibly an attempt to remedy the pre-war deficiencies of the British Consular service as regards the dissemination of commercial information, a branch of our intelligence which has been rightly the subject of severe criticism. The new Department works *inter alia* by distributing information through circulars or the medium of the press; by dispatching expert missions to study overseas markets in co-operation with trade associations, by supplying miscellaneous trading information to bona fide exporters of British goods; and by organizing trade fairs in the United Kingdom and arranging exhibitions of foreign goods and catalogues for the guidance of British manufacturers. Its principal medium is the *Board of Trade Journal*, a sevenpenny weekly of commercial information.

The Department have lately issued a Handbook giving briefly some account of the activities of the department as well as lists of its technical and commercial

Notes and Comments.

advisers and its commercial diplomatic officers throughout the world. Copies of this handbook can be obtained free by United Kingdom merchants and manufacturers on application to the Department of Overseas Trade, 35, Old Queen Street, Westminster, London, S.W.1.

Beet in the United Kingdom.

The only beet factory at work this campaign in England is Cantley, which is expected to produce over 5000 tons of sugar derived from 30,000 tons of roots grown on 3000 acres. The company running the factory was late in making its contracts with the farmers or more roots might have been forthcoming. Next year indications are that at least 6000 acres will be under cultivation. The full capacity of the factory is about 8000 tons.

Kelham is not of course working a crop this year, but is said to be making good progress for the 1921 season. The company has fixed the price of next year's roots at 80s. per ton delivered at the factory. Trial crops at Kelham last year yielded roots containing 17 to 18.5 per cent. of sugar.

The Development Commission and Beet Growing in England.

The tenth Report of the Development Commissioners (for the year ended March 1920) reviews the work done during the last ten years by a body instituted to carry out the provisions of the Development Fund, a measure originated and financed in 1909 by Parliament for the purpose of assisting the promotion of agriculture within the United Kingdom. It will be remembered that this body took up the question of sugar beet growing in this country and advanced funds in its aid. The following is the summary of the Commission's work in connexion with this branch of agriculture as given in the Report in question.

Before the creation of the Development Fund experiments made by private growers and on the farms of Agricultural Colleges had proved the possibility of growing beet in this country; and in 1911 the Board of Agriculture promoted a number of field trials for the purpose of testing the varieties of beet best suited for cultivation in England, and of obtaining precise information on such points as the preparation of the land for sowing, the quantity of seed desirable, the manuring required, and the cost of growing. When, therefore, the Commissioners first considered the action which they should take to develop the cultivation of this very important crop, it seemed to them that they should aim at the establishment of a beet sugar factory in a locality well suited for growing beet. They were informed, however, that any assistance which the Fund might provide for the erection of a factory would be regarded as a bounty, within the meaning of the Brussels Sugar Convention, and that in view of treaty obligations this country could not devote public funds to the purpose. In the year ending 31st March, 1912, therefore, the Commissioners refused to recommend an application which had been addressed to them for assistance in encouraging beet growing, as in the absence of a factory, it was undesirable to encourage farmers to grow beet. In 1913 the Commissioners again had applications for assistance for beet growing before them. By that time private enterprise had provided a factory at Cantley in Norfolk, and it seemed desirable to give such aid to this movement as was permitted by the limitations imposed by the Act, and by treaty obligations. A Sugar Beet Growers' Society was formed, and to this Society an advance was made to be applied to the work of organizing and instructing beet growers in Norfolk and Suffolk.

In the early years of the war the Commissioners had several proposals before them for developing the sugar beet industry, but were unable to support any

scheme which would, at the same time, meet the legal requirements of the Development Act, and be defensible on financial and administrative grounds. In the autumn of 1916 an application was received from the British Beet Growers' Society for a loan to enable them to purchase an estate of about 5600 acres at Kelham, near Newark. In view of previous experience it appeared to be essential to associate any factory erected in this country with a large area of land suitable for beet growing, as until farmers are accustomed to the new crop, they cannot be expected to grow a sufficient quantity of beet to keep a factory fully employed. The land at Kelham was reported to be very suitable for beet growing, and in 1917 and 1918 the Commissioners approved advances of about £170,000 as loans for the purchase of this estate and for working capital. A public company has now been formed and has acquired the estate for the purpose of growing beet and manufacturing sugar, and the British Sugar Beet Growers' Society has repaid the advances made to it from the Fund.

Sugar Production in China.

In a recent issue of the *Sugar News* of Manila, Mr. GEORGE FAIRCHILD gives some account of the conditions and extent of sugar production in China, a country which while it has grown sugar cane from time immemorial, has never figured in the world's list as a producer of any moment. This is partly due to the fact that, as in India, what sugar is produced is consumed locally, and so does not directly enter the world's markets.

According to Mr. FAIRCHILD, the modern production of cane sugar in China is confined to eight provinces—Szechuen, Kuangsi, Kiangsi, Chekiang, Honan, Yunnan, Fukien and Kwang-Tung. Data as to the exact quantity produced annually are difficult to obtain in China, but it is believed that the production at the present day approximates to 350,000 short tons, as against 400,000 to 500,000 tons some 40 or 50 years ago. The decline in production thus revealed is said to be due to increasing importation of foreign sugars of a quality much superior to that of the native product. Szechuen province is the largest producer with 133,000 tons to its credit, while Kwang-Tung comes next with some 100,000 tons. In 1884 over 100,000 tons of sugar were exported to foreign countries but now—adays from 6500 to 20,000 tons of sugar is sent annually from interior provinces to Hong Kong and Shanghai to be refined; and most of this sugar, as refined, is returned to China for consumption there. The northern part of China imports sugar from Japan, while the southern provinces get their imports from the Philippines and Java. Taking the indigenous production at 350,000 tons and the imports from foreign sources at 450,000 tons, we arrive at 800,000 tons as the amount apparently consumed annually by 400 million people. As contrasted with this, 65 to 75 million Japanese consume half a million tons of sugar a year. But the low per capita consumption shown by these statistics (4 lbs. per head) is said to be misleading, since many Chinese satisfy their demands for sweets by means of syrups made from sorghum or honey. Still, it is clear that there is an immense scope for further expansion of the world's sugar industry as nations like the Chinese and other orientals develop a taste for sugar.

Recent Company Reports and Dividends.

The last three months of the year witness the annual meetings in London of a number of sugar companies whose headquarters are situated in England, though their operations are in various colonies or foreign countries. Amongst them, the following will be found of interest.

Notes and Comments.

The St. Madeleine Sugar Co., Ltd.—This company was reconstructed about a year ago by liquidation of the old company, whose capital—£150,000—was considered to be a considerable undervaluation of the property on a post-war basis. The authorized share capital was raised to £750,000 and the issued capital to £600,000. Incidentally, the company sold last March its oilfield rights for £100,000, of which £75,000 was distributed amongst the shareholders and the remaining £25,000 was retained by the company. Subsequently, the company issued 100,000 additional shares for the purchase of the adjoining estate of Malgretout, thereby raising the total issued capital to £700,000. The sugar made during the year came to 17,510 tons against 16,402 tons in the previous season. The total profit for the year was £93,448, out of which the directors allotted £7202 for the staff fund, leaving £86,246 subject to excess profits duty, corporation and income taxes. Although the profits have increased as compared with the previous year by £25,356, and the directors considered it a satisfactory return all things considered on the increased capital, they did not recommend that any dividend be paid owing to the uncertainty of the outlook due to the heavy fall in sugar prices. The sugar was sold in advance at a price which showed 100 per cent. profit on the capital as it then stood, but, unfortunately, at a period prior to the sensational rise in sugar prices; otherwise a much bigger profit might have been shown. It may be added that when this company made its sale it reserved a moderate quantity of its output for making plantation white sugar,¹ and at one time it looked as though they were about to secure a remarkably fine profit on that portion; but, unfortunately, before this sugar could be made and put on the market, the price débacle set in and spoilt the prospects.

Leach's Argentine Estates, Ltd.—The trading profit of this company for its last financial year amounted, after providing for taxation, to £268,792 as compared with £325,126 in 1918-19. The reduction in profit was due to a lower selling price for sugar in Argentina consequent on the total production of sugar there being in excess of the consumption; £54,871 has been written off for depreciation and £50,000 carried to the reserve, the balance of profit available for distribution being £121,958 as compared with £121,069 last year. The company has taken steps to maintain the efficiency of its sugar factory, and new machinery has been ordered and a large part of it shipped, though the very heavy cost of materials and labour has forced the directors to modify the original scheme of improvements recommended by the local administrators.

Sir J. L. Hulett & Sons, Ltd.—This well known Natal company had a very satisfactory report for its last financial year ending June, 1920. The net profit, after providing for debenture interest but before placing anything to reserve, was £145,700 as compared with £80,800 the previous year. Fortunately, the year was free from disasters such as the floods which occurred in 1917 and 1918, so no losses of that nature have had to be written off, and a dividend of 13 per cent. (as compared with 10½ per cent.) has been declared by the directors, while £50,000 has been placed to the reserve, which now amounts to £241,600; it is proposed to capitalize £100,000 of this reserve in order to provide for further developments of the property, including extra new milling machinery. The main cause of the company's added prosperity has been the advance in the control price of sugar, which went up from £23 to £29 5s. per ton in November, 1919, and to £41 in June, 1920. After the close of the financial year the price rose yet further to £51, which means a very considerable advance in earnings, all the more as the crop

¹ Made, we understand, by the Bach process.

amounted to 51,200 tons as compared with 45,300 tons. Not only was a larger acreage put under cultivation, but there was also a higher yield of cane per acre.

Incomati Estates Ltd.—This Portuguese East African estate has declared a dividend of 25 per cent. on the ordinary shares and has since then issued 150,000 new ordinary shares which have been fully subscribed. The profits, which amounted for the year to £17,801, were less than anticipated on account of the depreciation of the exchange at Lisbon, whither a certain proportion of the sugar had to be sent in accordance with the Portuguese Government control of Mozambique sugar. The average price obtained for the crop at the estate was over £36 per ton but the actual price realized in Portugal converted into sterling worked out at only £18, as compared with £65 for the balance of the crop. This made a difference of £20,000 to the amount of the profits. For the 1920 crop the Government first stipulated that 70 per cent. should go to Portugal at a price working out at the estate of £26 per ton. The rest of the crop was sold to the Royal Commission in England for £90 f.o.b. Subsequently the Portuguese Government altered its requirements and demanded terms which the directors declared would involve a loss of £5 per ton on all sugar sent to Portugal. The matter is being taken up with the Government at Lisbon and urgent representations are being made; till a decision is reached and a more favourable position assured, the company are naturally unable to commit themselves to much new expenditure. It may be added that this company has acquired a small holding in Mauritius sugar production, having bought the Pieterboth estate in that island where about 4750 tons of sugar is being produced this crop, and the amount available for export, this crop, has been sold to the Royal Commission.

Peruvian Sugar Estates.

According to the *South American Journal*, two important sugar estates until recently under British control and another under American control in Peru have during the past few months been purchased by Peruvian capitalists. The Hda. Infantas, owned by W. R. GRACE & Co., has been sold for \$1,750,000 (U.S. currency) to the Sociedad Agricola Infantas y Caudivilla, Ltda. This property was purchased in 1917 by W. R. GRACE & Co. for the sum of £p.261,000, in connexion with the foreclosure of a mortgage on the estate held by the Banco Aleman Transatlantico. The area is about 790 fanegadas.¹ The Hda. Puento Piedra, owned by MILNE & Co., has been sold for £350,000 (sterling) to the Sociedad Agricola Puente Piedra, Ltda., in which the principal interests are said to be Sr. Manuel Mujica Carassa, Barber, Vargas and Co., and the Banco Popular. The area of this estate is about 420 fanegadas¹; both of the above estates are located between Lima and Ancon. The Hda. Santa Barbara, located in Canete valley some 100 kilometres to the south of Lima, has been sold by the British Sugar Company to the Sociedad Agricola Santa Barbara, a Peruvian syndicate. This heavy investment of Peruvian capital in the above properties is a direct result of the war prosperity which the country has been enjoying for the past three or four years.

The American Sugar Refining Company.

According to the *Cuba Review*, the annual report of the American Sugar Refining Company for the calendar year 1919 shows an increase in volume of business done from \$200,000,000 to \$300,000,000 compared with 1918. The profits from operation were \$10,283,081.92. The operating profit on the \$300,000,000

¹ 1 Fanegada equals 1.80 acres.

Notes and Comments.

volume is about 3 cents on each dollar of turnover, and is described as a margin so narrow as to be very near an even break.

The company's share of the sugar business of the United States has decreased from 60 per cent. in 1900 to 27 per cent. in 1919, and the business of its competitors has increased correspondingly. To put the company in position to share the general growth of business with competitors, it is increasing its capacity at Boston, making ready to build a new refinery at Baltimore, and has purchased a raw sugar plantation, Central Cunagua, in Cuba. The company owns but six of the 22 cane sugar refineries of the U.S.A. It has 20,665 stockholders, with average holdings of 44 shares each.

According to the report, \$564,124.70 has been paid out in pensions, \$143,204.22 in sick and injury benefits, and \$55,800 in group insurance. At the end of the year there were 8187 employees insured with policies aggregating \$5,755,600 covered in one of the largest policies ever written. All employees are insured after three months' service, without charge to them. The company maintains stock purchasing plans under which employees on the administrative, sales and clerical staff have purchased 5823 shares of a par value of \$582,300.

Royal Commission on the Sugar Supply.

Revised Sugar Prices.

The Food Controller announced on December 31st that the retail price of sugar would be reduced as from Monday, 3rd January, 1921, by 1d. per lb., following on the reduction of 8s. per cwt. in the wholesale price, which took place on December 28th, 1920. It was not expected that any further reduction in the retail price would be made before January 31st, 1921, when prices would be revised in the light of circumstances then ruling. The revised prices for January were:—

CLASS.	Wholesale, as from Dec. 28th, per cwt. Discount, 1½ per cent.	Retail, as from Jan. 3rd, 1921, per lb.
0. Castor, Icing, Pulverized	78s.	9½d.
1. Cubes, Loaf Sugar	76s.	9½d.
2. Granulated, Crystals, Crushed and Chips, Dry White Sugar, White Pieces (moist)	72s.	9d.
3. W. I. Grocery Crystallized Yellow Crystals, W. I. Muscovado (moist), Pieces (other than White), W. I. Grocery Syrups	Price must not exceed that fixed for licensed "free" sugar.	
4. Jellies, Knots, Lumps, and other Low Grade Sugar to be sold only to manufacturers	Uncontrolled.	

Licensed "Free" Sugar.—The maximum "reasonable" wholesale price for all licensed "free" sugar has been fixed at:—

Wholesale, as from Dec. 28th, per cwt., discount 1½ per cent. .. 72s.

Retail, as from January 3rd, 1921, per lb. 9d.

Syrup and Molasses will be sold by refiners at prices approved by the Commission.

The Japan Sugar Company has lately been experimenting in the cultivation of sugar beet in Korea, where last year an area of about 6500 acres was devoted to this product and the average yield is estimated at about 20 tons per acre. The sugar content of the roots is said to be good, and as the district seems to be favourable for sugar beet cultivation, the Company are planning to encourage still further its cultivation with the object of securing locally a regular supply of raw material for their refinery at Pyang-yang.

Fifty Years Ago.

From the "Sugar Cane," January, 1871.

It appears from this issue of our predecessor that what was here regarded as a modification of the diffusion process had been patented in Queensland by E. F. HART, who is stated to have erected a factory in that colony in 1868 for its operation. "Cane cut into slices $\frac{1}{4}$ to $\frac{1}{2}$ in. diam. by a machine like an ordinary chaff cutter" was placed in a vat and steamed for about 10 mins., following which the vessel was filled with hot water, and the liquid boiled. After 10 mins., the juice was allowed to flow into another vat immediately below, in which cane slices had also been introduced. This operation was repeated in the case of three other tanks, placed one beneath another, and when the juice had reached the fifth or bottom vat, the cycle was repeated, until finally the contents of each vat had been submitted to the extraction treatment five times. After tempering, the juice was concentrated in an ordinary open fire battery, and it was noticed that "the evaporation took a somewhat longer time than ordinary cane liquor, as the excess of water used for extracting the juice had to be evaporated," which excess, it was said, should not have been more than 10 to 15 per cent. It was claimed that "all the saccharine matter of the cane" could thus be obtained.

An interesting article on the "grist" of char was contributed by WILLIAM ARNOT, who drew attention to the very varying state of division of this material which could be observed, one sugar-house using material "the mechanical appearance of which is but little removed from that of fine sand; another abiding exclusively by chips as large as peas; while every intermediate size of grain is to be found in different refineries. . . . It must be manifest that before the full value of the char can be realized, every pore must be filled with the sugar liquor or syrup. Nor is this all; there must be a continual replacement of liquor in every pore as the process goes on. With a heavy liquor and large-grained char, this is very difficult of attainment; the pores once charged with thick gummy syrup, the succeeding portions of syrup will to a great extent pass over the char, without passing through it, the result being that but a fractional part of the decolorizing power of the agent has been utilized. It is only when the operation of washing is commenced that replacement takes place, and even then with difficulty. . . . Now, not only is there a greater difficulty in the replacement of liquor in the interior of large grains, but the interstices between the grains are larger and give freer passage to the liquor than in the case of char of smaller grist. . . . What the refiner has to aim at, therefore, is to have his char of such a grist, and in such a condition, that the whole power of the agent will be fully utilized, and that filtration will go on at a reasonable rate of speed."

Two other articles that appeared in this number of the *Sugar Cane* may be mentioned more briefly. The first gave a series of extracts from a recently published work by L'ABBÉ MOIGNO, entitled "Saccharimétrie optique, chimique, et melassimétrique," the processes described being (1) that of PAYEN, in which wash-liquors consisting of alcohol saturated with sucrose and rendered acid with acetic acid were employed; and (2) those of BARRESWIL and FEHLING, a procedure for the determination of the "glucose" and sucrose, by determining the reducing power before and after inversion, being minutely described. The second article here published called attention to Scheibler's proposal to use alumina cream for the clarification of sugar solutions previous to polarization.

Production of Sugar in Soviet Russia.

(From a Correspondent.)

According to Bolshevik figures (*Ekonomicheskaya Zhizn*, No. 212), in 1914 in Great Russia and the Ukraine, i.e., in Russia without Poland, the area planted with beet was 797,373 dessiatinas (1 dessiatina = 2·7 acres) and the quantity of sugar produced 105,421,100 poods (62·03 poods = 1 ton).

This year's output of sugar is expected to be 8,000,000 poods (*Ekonomicheskaya Zhizn* for October 13th, No. 230), being 6,000,000 from the Ukraine and 2,000,000 from Great Russia. The area planted with beet in 1920 was 167,222 dessiatinas (*Ekonomicheskaya Zhizn*, No. 257). The same issue of that paper contains the explanation given by the Bolsheviks of such an astounding decrease in the production of sugar.

"During the years of the war and of the revolution the beet-sugar industry fell into desuetude; the majority of the highly cultivated estates in the south were ruined, their stock pillaged, and the plantations broken up among small holders, 75·9 per cent. of whom are peasants. There is no expert agricultural assistance to be had, the rotation of crops is disturbed, and the plantations are scarcely manured at all. All this has lowered their productivity very much; the harvest of beet has fallen from 900-1000 poods per dessiatina to 500-600."

Little can be added to this explanation, and after this one can scarcely attribute the lessened output of sugar to the blockade. The sugar industry began falling from the beginning of the war. In 1915 the output was only 91,000,000 poods, and in 1916 72,000,000 poods, i.e., 75 per cent. of the preceding year, and in 1917 55,000,000 poods, i.e., again 75 per cent. The fall assumed an especially catastrophic character beginning with the revolution of 1917, when, under the influence of socialistic and revolutionary ideas and the encouragement of the Majority political parties, the peasants began sharing among themselves the sugar beet plantations and the stock of the sugar refineries. In 1918 the output of sugar sank to 20,000,000 poods, i.e., to about 30 per cent. in comparison with the preceding year. In 1919 it fell to 4,700,000 poods, i.e., to 8 per cent. of the output of the last pre-revolutionary year. True, in 1920 it is expected to rise to 9,000,000 poods, but all the same that would be only 16 per cent. of the output of the year immediately preceding the revolution. The figures given by the *Ekonomicheskaya Zhizn* do not quite agree with each other: in No. 212 the paper states that the output for the current year will be 9,000,000 poods, while in No. 230 it gives 8,000,000 poods of sugar as the figure. Thus, though the production of sugar had been falling throughout all the years of the war, after the revolution it assumed catastrophic dimensions.

Nationalization and centralization disorganized the sugar industry. In many of the more remote localities the population was beginning to forget what sugar was. The Bolsheviks distribute food in far smaller quantities than the poorest inhabitants enjoyed before the revolution. The expected output of sugar will suffice for its distribution according to the Bolshevik norms, but these norms are small. The *Ekonomicheskaya Zhizn*, No. 230, says:—"The annual amount of sugar needed for the population of the Russian Soviet Federative Socialist Republic, with the observance of the existing norms and the limitations for the existing categories of consumers, is about 6,000,000 poods, if urgent measures are taken for bringing in sugar from the Ukraine and if the programme of production appointed by the Chief Sugar Administration is carried out."

At best, therefore, the population of Soviet Russia will receive 240,000,000 lbs. of sugar, or, reckoning the population as not less than 100,000,000, about 2.4 lbs. per head per annum, i.e., 0.2 lbs. per month. But in Soviet Russia people do not all receive an equal share, and many will not receive even a tenth part of this ration. In 1913 the amount of sugar per head of the population of Russia was 19 lbs. a year or 1.58 lbs. per month, notwithstanding the Government limitation of the quantity of sugar put on the home market.

The Mosaic or Mottling Disease of the Sugar Cane.

The Main Facts of the Case to Date.

Mosaic of the sugar cane is perhaps the disease of the hour. This is not necessarily because it is the most widely distributed or the most important, but rather because two parts of the United States, noted for the excellence and profusion of their publications on agricultural matters, are undergoing a somewhat acute phase of anxiety on account of it. In Porto Rico it has been noted sufficiently long for a fairly detailed estimate to be made of the losses attributable to it; although it may well be doubted, in view of the facts presented in the paper on Root Disease in that island in the last number of this journal, whether at some future and calmer moment, the figures given may not be regarded as the reverse of conservative, as they are now claimed to be. And, in the United States, the officers of the Agricultural Department, alarmed by these figures, have with characteristic energy investigated the matter, and, within a year of the discovery of the disease there, produced a mass of evidence that it has caused serious losses during recent years, and published broadcast the means by which it can be kept under control.

Our attention was first directed to this disease, possibly long familiar to us in the cane fields of the tropics, by a lively controversy in our contemporary, the *Louisiana Planter*, in which the scientific workers in Porto Rico and Louisiana and to a less extent in Hawaii on the one side, and those in Cuba and Argentina on the other, became involved. While it is said to be a serious disease in Hawaii, it has been known there since 1910 and is under control; in Porto Rico it was first detected in 1915, and is rapidly enveloping the whole of the island and causing much loss; in the continental United States it was definitely named in 1919, and was then found to have spread to all of the sugar-growing States in the south; in Cuba it had been noted by responsible officers 18 years ago, and is of local distribution and minor importance; while in Argentina it has been present for at least 15 years, and is now so universal that it is almost impossible to find a single plant free from it; here, again, it is not regarded as serious.

With these various and conflicting opinions before us, we watched the contest and "sat on the fence," having no means of judging the validity of the arguments on either side. But a series of exhaustive papers have recently been published by American workers in Porto Rico and the United States, and we have been able to form more definite conclusions as to the real state of affairs. We propose in this article to lay these conclusions before our readers, without in any way claiming to be arbiters in such matters as are still in dispute. We merely intend to try and summarize the more important aspects of the question, as detailed by the responsible officers on the spot, whose attainments are unquestioned and whose opinions are worthy of the most careful consideration.



The Mosaic or Mottling Disease of the Sugar Cane.

It may be well, in the first instance, to give a short résumé of the controversy as presented by the articles in the *Louisiana Planter* during the past year, the figures in brackets giving the date and page of each of these.

(1) J. R. JOHNSTON, a recognized authority on cane diseases in the New World and until recently Pathologist at the Central Experiment Station in Cuba, opened the ball (July, 1919, p. 43) with a reference to recent articles in the Havana papers which indicated that the Mosaic disease was present in that island. He detailed the main character of the disease in Porto Rico as follows:—Its cause was unknown, but it was not a simple chlorosis; it was injurious and transmitted by cuttings; the soil was incapable of transmitting it, and it was incurable; its attacks differed in different varieties, from immunity to heavy infestation, from serious damage to considerable resistance; it might remain harmless for a series of years and then suddenly leap into prominence and spread rapidly. The disease appeared to be identical in Porto Rico and Cuba, as well as in Hawaii and Java, where it had been known as Yellow Stripe for some time; it was therefore advisable to watch it carefully in Cuba.

(2) This paper of Johnston's provoked a reply from R. M. GREY, Superintendent of the Harvard Experimental Station, Cienfuegos, Cuba (August, 1919, p. 90), contesting Johnston's facts. GREY stated that he had found the disease 18 years before and had kept it under observation for 14 years. He had carefully examined it and, as the result of innumerable observations and experiments, considered that it did no damage; he further stated that it was not incurable, and claimed that he had repeatedly succeeded in eliminating it by improved cultural methods; he had never found a case where it was fixed and permanent; "mottling disease causes absolutely no injury in Cuba, and if root disease and leaf rot could be eliminated we might forget it."

(3) The Editor of the *Louisiana Planter* (August, 1919, p. 82) drew attention to Grey's paper, and quoted the case of frog-hopper in Trinidad, where far less injury was caused where the earth had been properly worked: and he also drew attention to the various alarmist predictions regarding borers which had not materialized and the divergent views held by scientific officers as to the usefulness, in fighting them, of burning the trash.

(4) As was natural, this brought Porto Rico into the field. F. S. EARLE, Expert in Sugar Cane Diseases, of the United States Office of Sugar Plant investigation, and now working in Cuba (September, 1919, p. 167), regretted the tone of recent articles in the *Louisiana Planter*. Considering that the behaviour of the disease was contradictory, remaining harmless for years and then suddenly springing into activity and causing widespread loss, it was the best policy to attack it while it was in the quiescent stage. Considering Gray's claim to have eradicated it by cultural methods, he suggested that that worker might have confused true mottling with the often similar attacks of insects and fungi. The disease was now widely spread throughout continental United States, and it would be unfortunate if planters there were lulled into a false sense of security. The Editor added a note to this letter maintaining the view previously expressed by him and referring to the campaigns against the cotton boll weevil and yellow fever, where success had, after enormous sums of money had been expended, been obtained through comparatively simple side issues.

(5) GREY, declining to enter into a discussion on the subject, simply stated (September, 1919, p. 199) that he had made no such mistake, and had cured the actual plants, identified by the United States experts as suffering from the Mosaic disease, in 116 days, and others equally badly affected in 59 days. He

suggested that, from what he had read, the weather and other natural conditions in Porto Rico seemed to be more severe than in Cuba.

(6) Lastly, G. L. FAWCETT, Botanist to the Agricultural Department in Argentina, a consistent student of sugar cane matters, wrote (January, 1920, p. 39) an article discussing the effects of Mosaic in that country, as probably of interest. He had noted the spotting of the leaves on reaching Argentina four years before, but, in the absence of apparent damage, had turned his attention to the really serious sugar cane diseases. Recently, this spotting had been identified by Porto Rican and Hawaiian experts as Mosaic. The disease was known 15 years ago in Jujuy province, and it was now practically impossible to find a single plant in Argentina not infected, except in a small area in the south of Salta, and that the infection was doing no apparent damage. The thick canes of the country had, it is true, been driven out, but he did not regard Mosaic as the cause. This was rather due to the difficulty of such varieties in rapidly establishing themselves after harvest before the cold weather set in, thus suffering from decay of the roots and stubble before the spring. Various Java seedlings, while freely infested with Mosaic, were better able to stand the adverse climatic conditions and the Mosaic did them no harm, as evidenced by the tonnage obtained. FAWCETT, however, disagreed with GREY in Cuba in one particular, in that he found better cultivation of no avail against Mosaic, nor had he ever seen a plant recovering from it when once attacked.

This controversy has been of great value, and justifies the conclusion that the disease is in some way dependent on local conditions, so that its behaviour is contradictory in different countries, as is so often the case with cane diseases. Like other diseases, it is capable of long periods of quiescence and harmlessness, but in certain circumstances may suddenly increase rapidly and become a serious infectious disease. And, such being the case, it is the only wise course to search for it everywhere, and when found to keep it under observation, meanwhile taking note of the methods which from time to time and place to place have been found to keep it in check. Thus, if it becomes dangerous, it can be at once treated with full knowledge so as to limit its harmful character. It might be mentioned, lastly, that the discrepancies brought out in this interchange of views in the *Louisiana Planter* should be cleared up, especially the claims that Mosaic can be influenced by better cultivation in Cuba.

In the following notes on Mosaic a number of papers have been consulted, the most important of which are mentioned below: these are such as have come, our way. It is claimed in Hawaii and elsewhere that Mosaic or Mottling is identical with the Java Gele Strepenziekte (Yellow Stripe), first mentioned by MUSSCHENBROEK in 1892 and subsequently studied by a number of other workers in Java. LYON of Hawaii gives the following distribution of Yellow Stripe:—Hawaii, Fiji, Australia, New Guinea, Java, Philippines, Egypt, to which may be added Porto Rico, San Domingo, Cuba, Argentina, St. Croix, and lastly (*I.S.J.*, 1920, pp. 669 and 670) Trinidad and Jamaica. It has in these places accumulated a multitude of names, of which Mottling or Mosaic seem to be the best. The latter name seems most likely to survive, because it is the name current in the United States and at present in Porto Rico, is descriptive of the disease and especially, indicates its relationship to the mosaics of tobacco and other plants.

The following are some of the main characters: a full description is impossible within the space available and will not be attempted. The chief character is of course a mottling or striping of the leaves caused by the occurrence of dots and short stripes of lighter green and, somewhat later, white, scattered over the

The Mosaic or Mottling Disease of the Sugar Cane.

darker green background of the normal leaf: these increase in number, coalescing in various ways so that the normal green colour becomes the exception and the whole leaf takes on a pale, often yellowish tint. A great variety of patterns is thus produced on the leaf, and these are distinguishable from those caused by fungi in that the invaded tissue does not die and turn brown, and from the spotting by sucking insects in that these are almost invariably surrounded by a pale almost circular area: the larger spots in Mosaic are invariably elongated. It is distinguished from the various forms of non-infectious chlorosis by the distribution of the light colouring which, in the latter, is usually local: in Mosaic the whole leaf is infected excepting sometimes at commencement. This affection of the main feeding organs of the plant, whereby the colour bodies are killed, is naturally accompanied in most cases by feebler growth, and the plants become stunted. The new internodes are shorter and thinner, and, at a later stage, show lesions or cankers on the surface, become less juicy and even pithy, until finally no commercial canes are produced and the field has to be abandoned. This last stage usually occurs in the third year from planting, but this will depend upon the relative power of resistance of the variety. The plants do not appear, however, to be killed by Mosaic: they merely become unprofitable from the crop point of view.

The disease is passed from generation to generation and field to field primarily by the sets, and as, once attacked, the whole of the tissues are affected, no part of a diseased plant can produce healthy offspring. But the disease is also highly infectious: a secondary form of transmission is quite obvious, for diseased plants rapidly contaminate all that are near to them and also, in many cases, appear to be able to do so over very considerable distances. It has been definitely proved that this secondary infection does not take place through the soil, and, once an abandoned field is ploughed up and none of the old shoots allowed to develop, perfectly healthy canes can be grown if taken from plants in their turn healthy. This negative action of the soil has been proved in various ways again and again, one experiment being to place healthy sets in pots from which diseased plants have just been removed. The mechanics of secondary infection has not to all appearance been definitely worked out as yet, but there is the strongest evidence that insects of the sucking kind, often powerful fliers, are concerned in this natural inoculation. Their action appears to be most effective, and yet all attempts to carry out artificial inoculation appear to have failed or, if they have succeeded, only so in the rarest cases. Insect carriers further explain the observed facts, and aphides and frog hoppers are suspected, acting presumably just as they do in the allied curly-top disease of the beet and some other diseases. In these cases a very small amount of virus is sufficient to infect a great many plants, and this may well be the case with cane Mosaic, as the spread of the disease by secondary infection is remarkable for its rapidity. The period of incubation appears to be from two to three weeks and the disease appears within six weeks or two months of planting.

No organism of any kind has been found in the tissues to which the disease can be attributed, and the view generally expressed is that we have here to do with an ultra-microscopic organism or perhaps a perverted enzyme,—which is, after all, rather a confession of failure, just as in the old days when an obvious fungus was not found in the tissues of a diseased plant it was often suggested that bacteria were at work. But the behaviour is so like that in cases of demonstrable infection by fungi or bacteria, and the number of similar unexplained epidemics is so great, that there is much to be said for the theory. This is one of the many riddles which

phytopathologists have to solve. There are quite a number of diseases, frequently rapidly spreading and very deadly, for which no adequate cause has been found. We need only mention the sereh disease of the sugar cane, the spike disease of sandal, peach yellows and curly-top in the beet. At first it was frequently held that the disease was induced or at any rate largely assisted by deterioration, another refuge for the destitute, or by bad weather, soils, manuring, cultivation, and this last has received some encouragement from the statements of GREY in Cuba. But, for the disease in its destructive form, the very complete study to which it has been subjected has knocked away these props one by one, till it is generally conceded that to no single one or combination of them can the disease by any chance be attributed, and there is nothing left to fall back upon but hypothesis.

The behaviour in different countries varies a great deal and this is yet another of the riddles with which the study is beset. At the same time, such differences should be of the greatest interest and open out a wide field for investigation, and appear to afford a series of clues which will doubtless be taken advantage of by the workers in those places where the disease is most feared. In Java it has been recognized as causing appreciable loss, but is apparently controlled by the continued planting of sound seed; it is suggested that the disease was, in any case, less virulent than in the New World in these latter days, and this has been attributed by some to a quantum of resistance acquired naturally by the cane plants long growing with the disease in their midst. Similar suggestions have been made by others regarding San Domingo and Cuba to be mentioned below. The Hawaii work, though doubtless very interesting, is not available; but it is indicated that, in fully infected fields (100 per cent.), the loss is from 5 per cent. to 40 per cent. according to the variety grown, and that this loss is in the *l*. deficient tonnage rather than diminished growth of poorer juice. In the early stages mottled plants grow well and their juices appear to be equally rich in sugar with healthy ones, but the stalks are always considerably lighter and presumably have less juice in them. In Porto Rico, four years' severe infection has made possible to advance more detailed figures than in continental United States. STEVENSON estimates that, up to July, 1919, some \$3,500,000 had been lost to the industry through mottling, and it is quite certain that the damage since then has been very serious. No statement can very well be made in Louisiana, for the disease was only definitely declared to be present in the same month (July, 1919), but, from such evidence as has been collected during the very detailed survey which has been concluded, it is thought probable that considerable losses have been experienced during the last few years. In San Domingo the disease is reported by STEVENSON as widely spread, but not assuming the severe form of the Porto Rico epidemic; no case of stem infection has been met with by that observer and he hazards the suggestion that the virgin soils of the cane plantations may have something to do with this. This has also been urged with reference to Cuba, and certainly the disease acts there in a totally different manner from Porto Rico and the United States generally. There seems, in fact, to be little or no secondary infection and the disease has difficulty enough to hold its own with the reproduction by diseased sets. It is, as will be gathered from the former remarks by GREY, regarded with equanimity. In Argentina, on the other hand, yet another case is presented. Here too the disease is not regarded as dangerous, but this is traced to the fact that the canes growing, although fully infected, are almost entirely of varieties which, everywhere and even in Porto Rico, have shown a very high state of resistance to Mosaic, the older varieties having been discarded in this sub-tropical region in favour of Java seedlings with North Indian blood in them.

The Mosaic or Mottling Disease of the Sugar Cane.

A natural means of fighting the disease is of course the introduction of immune varieties, the final refuge of all who have failed in their attacks on plant diseases. But, unfortunately, the only varieties which have hitherto been shown to be immune are such as cannot be commended for growing in tropical cane fields. Such are the Kavangire, determined by Cross to be identical with Uba, Cayana 10 used for syrup in the United States, and other so-called "Japanese" canes wherever found; typically thin, fibrous, freely tillering canes, possibly all of the great Pansahi group of Indian canes. Besides these there is the possibility of some new seedlings being found which are immune, but at present more than 1000 kinds have been shown to be susceptible, including all the well known canes of commercial value and multitudes of seedlings; and, considering the parentage of the latter, it seems at least improbable that they will be found to differ from their parents in this matter of immunity. But we must here distinguish between immunity and resistance, two very different things. The Java seedlings referred to above are not in the least immune and take the disease with the greatest ease, and it is possible that they have introduced Mosaic into the new world; but its effect on them, although varying, is very slight, and perfectly good yields can be obtained from 100 per cent. infected fields. The suggestion that this resistance is due to long experience of the disease in Java has already been referred to; but it seems to us to be much more likely that they owe this favourable character to their parentage which is half North Indian, although in a different group to that of Kavangire. The Sarethia group, to which their male parent belongs, is a much hardier one in India than the Pansahi. There is hope however in this matter of resistance, for the thick canes vary greatly in it: quite a number are mentioned in the various papers referred to as more resistant than the rest, and trials have commenced with these both in Porto Rico and the United States. Thus, G.C. 888 and G.C. 1313, D 1135, D 117, B 6540 and L 511 are said to be worth multiplying for this reason, and L 1646, L 1606, L 1674 and L 1797 even show signs of possibly being immune.

One of the most interesting features in the case, which has only recently received attention, is that the particular virus attached to Mosaic in the sugar cane is capable of producing a similar disease in various other members of the grass family. This point has as yet by no manner of means been fully worked out, but Mosaic occurs, according to BRANDES, in maize, rice, "millet," sorghum, "Panicum," foxtail and crab-grass. The disease is said to attack these plants with difficulty even under favourable conditions; but, while it is likely that all of these plants can be infected directly from sugar cane, this has only been proved in the case of the last four. These became heavily infected when grown in the same greenhouse as diseased sugar canes while plants growing all around outside remained without a sign of Mosaic. The importance of this aspect of the matter cannot be overrated. It is sometimes assumed that the disease was originally one of some wild grass which handed it over to the sugar cane, and this idea receives some support from the peculiar mode of extension in Porto Rico where it was at first chiefly met with in the hilly tracts. However this may be, the possibility of the wild grasses bordering cane fields acting as carriers is alarming enough for a detailed search to be made on plantations for any signs of the disease in the wild flora as well as in adjoining crops.

The control of Mosaic has, as in scab and many other diseases, outstripped our scientific knowledge of its character, and is planned upon a recognition of a couple of clear cut factors. Diseased plants will always transmit the disease through cuttings taken from them, and secondary infection always takes place

when susceptible varieties are planted near those affected. When the characters of the disease are universally known to planters and they can readily distinguish Mosaic plants from those with leaves otherwise marked, it should be easy rigidly to abstain from taking sets from diseased plants. In one case we can go further, for EGERTON has shown that, in L 511, we can at once distinguish diseased canes after they have been cut, that is at the mill: diseased canes in this variety are stated always to have red stripes and these are entirely absent in healthy plants. But, ordinarily, one must depend on the blotching of the leaves and therefore make the selection for planting before cutting the canes. It would, moreover, be much the wisest course to secure healthy seed from fields in which no Mosaic occurs, for there appears to be an incubation stage of two or three weeks, during which infected plants may show no trace of the disease in their leaves, although the virus has already been introduced into their systems. It is a fundamental plank in all measures at present suggested for the control of the disease, that every diseased plant will pass on its virus in its cuttings and that no healthy plant can do so. But this is only half the battle. A few diseased plants, in an otherwise healthy field, will rapidly infect the whole field once the leaves are out, for we gather that this secondary infection takes place only through the leaves. Therefore a system of "roguing" is necessary, and it is important that this operation should be carried out as soon as the first trace of the disease declares itself, namely when the plants are quite young. It is moreover necessary to dig out the whole stool, so as to destroy all the buds which otherwise may later shoot out their leaves to carry on the infection. These dug out stools need not be burned or otherwise destroyed, for it will be sufficient merely to throw them into the middles between the rows. This sounds very extraordinary practice in a highly infectious disease, but it has been shown that wilted plants are not to be feared: we presume because the suspected insect carriers will not find any juice in their tissues and will confine their attention to the more succulent growing plants in the rows. This main factor of insect carriers has constantly to be borne in mind, and the roguing should therefore be done before they enter the field of young canes, or are present in large numbers.

An eradication campaign has been started in Porto Rico, and EARLE has given the results of the first year's work in the words of those planters who have adopted his suggestions. The work was admittedly carried out with varying thoroughness, and the results obtained agree closely with this. The cost in cases of slight infection appears to have been very moderate, often under a dollar per acre but, in cases where 30-50 per cent. of the plants in the field were affected through the planting of diseased sets, it naturally was a great deal more. At first it was not intended that eradication should be attempted in such cases, but the results of the first year's work have proved so eminently satisfactory, that it is now suggested that it might be attempted in all fields, and that even such as have 100 per cent. of diseased plants need not be excluded. In these cases, however, nothing can be done in the absence of a ready source of healthy seed cane, and this is of course difficult to introduce. If this source is available the infected canes should be crushed without any attempt at using them for seed purposes. Where the sound seed is insufficient to plant up the whole area of healthy fields these should be kept as far as possible from the diseased plots, and increased rapidly for seed purposes. Ratooning should be totally discontinued in fields suffering heavily from Mosaic.

The second line of control is the introduction of immune and resistant or tolerant varieties. Unfortunately, as already stated, the only ones at present

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known to be immune are those of the Uba or Kavangire class, and it is for the planters to decide whether these canes are worth growing for sugar making. They are definitely inferior to the tropical canes in certain particulars and are not therefore to be recommended for general use in the tropical belt where thick canes can be grown. With regard to resistance, there is a better prospect of success. A good deal of work has already been done on the subject. We know, for instance, that all of the Java seedlings which have North Indian blood in them are highly resistant. Although readily taking the infection, the presence of Mosaic has little influence on the greenness of the leaves: the growth is good and the tonnage heavy, while the juice does not appear to suffer at all. Here again it is for the planter to decide whether they are sufficiently rich in sugar to be introduced on a large scale in place of the former more tropical varieties which have been so badly hit by the disease. But there are, among the latter class, great differences in their degree of resistance, as has been shown by EARLE in another paper. Some of these have already been mentioned, and it is desirable that this work of selection should be strenuously pushed forward, and such as have responded favourably multiplied as rapidly as possible.

These appear to be the main facts of the case regarding Mosaic at the present moment. With the amount of energy being thrown into its study, it is certain that new facts will be brought to light, and the views expressed in this article will suffer change in various particulars. But, supposing that there is no alteration in the main facts of the case, there seems to be a probability that Mosaic will be mastered in place after place, and will again take its position among the minor diseases of the cane, many of which have, in their turn, assumed alarming proportions for a time. One fact is obvious: if the industry is to be carried on successfully and such visitations are not, every now and then, to catch the planters unawares, a greatly increased attention will have to be paid to the fields in the future. It is of little use to devote exclusive attention to the factory if the source of supply is liable at any moment to be cut off.

J. R. JOHNSTON (and others).—Diseases of the sugar cane in tropical and sub-tropical colonies, especially the West Indies. *West Indian Bulletin* XVI, 4, 1918.

C. W. EGBERTON.—Mottling disease or Mosaic of the sugar cane. *Louisiana Planter*, June, 1919, p. 397.

J. A. STEVENSON.—The Mottling or Yellow Stripe disease of the sugar cane. *Journal of the Department of Agriculture, Porto Rico*, IV, 1 (III, 3?), July, 1919.

C. O. TOWNSEND, United States Department of Agriculture.—An immune variety of sugar cane, *Science*, May 16th, 1919 (*Louisiana Planter*, July, 1919, p. 43).

F. S. EARLE.—Resistance of cane varieties to Mosaic disease. *Bulletin 19, Insular Experiment Station, Porto Rico*, August, 1919.

F. S. EARLE.—Eradication as a means of control in sugar cane Mosaic or Yellow Stripe. *Bulletin 22, Insular Experiment Station, Porto Rico*, 1919.

E. W. BRANDES.—The Mosaic disease of sugar cane and other grasses. *Bulletin 829, United States Department of Agriculture*, October, 1919.

E. W. BRANDES.—Artificial and insect transmission of sugar cane Mosaic. *Journal of Agricultural Research*, XIX, 3, May 1st, 1920.

E. W. BRANDES.—Mosaic disease of corn. *Ibid.*, XIX, 10, August 16th, 1920.

C. W. EGBERTON.—A new method of selecting L. 511 cane free from Mosaic for planting. *Louisiana Planter*, October, 1920, p. 212.

C. A. B.

A recent addition to the ranks of sugar producers in Natal is the Uba Co-operative Sugar Milling Co. which has raised a capital of £650,000 and is said to be spending £420,000 on factory plant.

The British Indian Sugar Industry.

Estimates of the 1920-21 Sugar Crop.

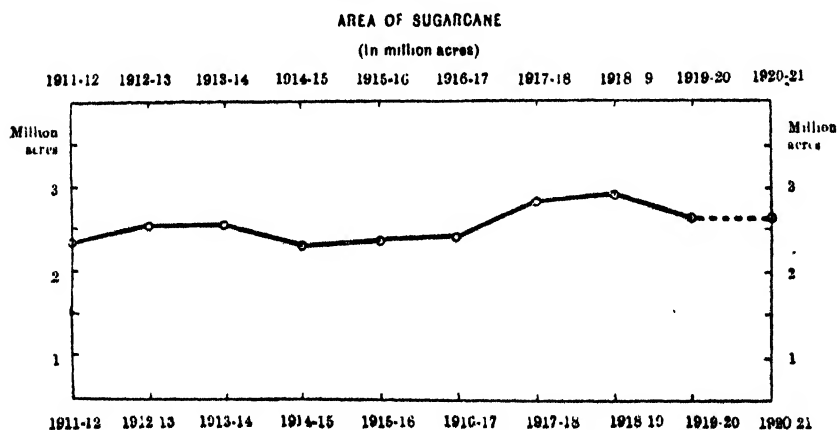
An official memorandum was issued at Calcutta towards the end of October, giving the second sugar cane forecast for the 1920-21 season in India; it was based on reports received from 99 per cent. of the total area under cane in British India.

As compared with the final estimate of last year, the present estimate shows a nominal increase of 2000 acres only. The detailed figures for the Provinces are as follows, the 1919-20 figures being the 2nd forecast a year ago and not the final estimate :—

PROVINCE.	1920-21. Acres.	1919-20. Acres.	INCREASE OR DECREASE. Acres.
United Provinces	1,434,060	1,500,000	— 66,000
Punjab	474,000	479,000	— 5,000
Bihar and Orissa	279,000	280,000	— 1,000
Bengal	220,000	219,000	+ 1,000
Madras	92,000	88,000	+ 4,000
Bombay and Sind (including Indian States)	77,000	71,000	+ 6,000
Assam	35,000	32,000	+ 3,000
North-West Frontier Province..	35,000	36,000	— 1,000
Central Provinces and Berar ..	21,000	21,000	....
Baroda	2,000	3,000	— 1,000
	<u>2,669,000</u>	<u>2,729,000</u>	<u>— 60,000</u>

The present condition of the growing crops is on the whole reported to be very fair.

The chart below shows the present estimate of acreage sown as compared with the final figures of area since 1911-12.



Ceylon's normal consumption of white sugar is said to be about 20,000 tons, derived mainly from Java, Hong Kong, Australia, and India. The Government are anxious to extend food production in the island, including that of sugar, and may introduce protective measures if a substantial sugar venture could be started. There is said to be sufficient suitable land to raise more than enough sugar to meet the local demands.

The Sugar Trade during 1920.

Messrs. William Connal & Co.'s Annual Report.

We reproduce below some large extracts from the excellent annual Report on the sugar trade of the past year compiled as in previous years by Messrs. WILLIAM CONNALL & Co., the well known Glasgow sugar brokers.

1920 will long be remembered as the year, during the greater part of which America ruled the sugar markets of the world, and during which many rapid and unprecedented fluctuations were experienced.

The British Royal Commission on Sugar Supply, and the American Equalization Board had jointly, during 1918 and 1919, controlled the sugar supplies for both Europe and America, and it was confidently expected that this joint arrangement would be continued during 1920. The Royal Commission's control of the British markets was to be continued, but as the existence of the Equalization Board expired on 31st December, 1919, there was a doubt as to its renewal. American refiners, in the summer of 1919, made an effort to have its continuance sanctioned, but this failed by the opposition of Washington. Had this effort been successful, the entire Cuban crop of 1920 could then have been secured by the two Boards at 6½ cents per lb. f.o.b., and this would have been of unspeakable advantage for the future of both Europe and America. Another effort for this purpose was again made in October, 1919, but through the illness and absence of the President, the necessary sanction of Congress was unobtainable, and when it had been obtained on 20th December the opportunity had been lost, for getting the necessary and complete control of the Cuban and other crops. During the period of uncertainty attending these negotiations European buyers and others for Eastern markets succeeded in securing a large portion of the early delivery of the 1920 Cuban crops at 6½ cents, and the Cubans were thereafter no longer sellers unless at an advanced price.

When it became evident that the Equalization Board would no longer exist, and that the American market was to be left uncontrolled, the Royal Commission at once commenced negotiations for the supply of their own wants, but it was then found difficult to buy on favourable terms, as they were brought into competition with American refiners. Their purchases made for early January shipment, and for which charters had been arranged, were unfortunately late in arriving at the shipping ports through strikes and failure of transports. This caused great inconvenience, and delay in shipments, so that arrivals in the United Kingdom proved lighter than had been arranged for during February and March. Great difficulties were all along experienced in the Cuban ports from the congestion of traffic arising from a succession of strikes. In the port of Havana, where there was a strike of long continuance, about 90 vessels were at one time held up awaiting discharge, and convicts from prison had to be employed for the unloading of perishable articles. The Royal Commission, however, succeeded in overcoming all difficulties and in having a fleet of steamers always on the passage. When the market opened in January there was the prospect of abundant supplies from Cuba as Messrs. GUMA then estimated the crops at 4,400,000 tons, but with active buyers and unwilling sellers the quotation for 96 per cent. polarizations, which was 10½ cents early in the month, had advanced to 12 at its close, the equivalent of 76s. 9d. per cwt. at 3.50 exchange.

In February there was, as usual, a large offering of ready sugars from both Cuba and Porto Rico, and with some pressure to sell, prices declined during the month, and closed at 9 cents, f.o.b., Cuba, the equivalent of 59s. 3d. per cwt. at

3.40 exchange. At this reduced price the Royal Commission were reported to have made important purchases.

There was active buying during March on the part of American refiners, who were experiencing a good demand for their refined, owing to general business prosperity, and the high wages which were being earned, but they found difficulty in obtaining full supplies of raw sugars, and strong competitive buying during the month caused a gradual improvement, from 9 cents at its beginning to 12 cents at its close. At this period Messrs. GUMA's revised estimate of the Cuban crop appeared, reducing it from 4,400,000 to 3,900,000 tons, and this reduction of about 500,000 tons led to an excited market and to active buying of sugar in all positions at an advance during the first week in April of 19s. 9d. per cwt., which was increased during the remainder of the month by a further advance of 16s. 9d. per cwt., making a total advance during April of 36s. 6d. per cwt.

This advance, which some Cuban planters described as being "almost too good to be true," was further increased in May, when it became evident that the long continued drought in the early part of the year had injuriously affected the substances of the canes, and from that cause many centrals were closing up with outturns much under previous estimates. This caused Messrs. GUMA again to reduce their Cuban crop estimate to 3,650,000 tons, and this new reduction led to an immediate burst of feverish and excited speculation, in which both Americans and Cubans took part. With the Cuban crops so greatly reduced, there was a prevailing idea that a sugar famine might be experienced, and, in consequence, a rush was made to secure sugar from any quarter, in any quantity, and at any price. This excitement led to a further advance of 28s. 1d. per cwt., and on 20th May 23½ cents were paid, the equivalent of 137s. 9d. per cwt. at 3.82 exchange. In expectation of a further advance, Cuban and Porto Rico sellers withdrew their stocks entirely from the market. This compelled American refiners, who were largely short of supply, to make large purchases, estimated at 300,000 to 400,000 tons, in Java and Maunila and the east, for shipment during summer and autumn months.

The sugar world looked on in amazement at this wild scramble to secure sugars, and every country, with any reserve of stock, willingly parted with it to America, that they might share in the wealth which was being so lavishly squandered. The 20th May proved the highest point of the market, and 23½ cents, the equivalent of 137s. 9d. per cwt., f.o.b., recorded an advance from the lowest point in February of about 80s. per cwt. There was the general expectation at this time that on account of the deficient Cuban crop by 700,000 tons, and reduced world's supply, a period of high prices was likely to be continued. It was forgotten, however, that high prices, sooner or later, caused decreased consumption, and brought into view many unseen, and unsuspected, sources of supply.

Meantime the Cubans, being under the impression that they were in a position to command the market, and that the Royal Commission had still unfilled wants, made them an offer of unsold stock at 130s. per cwt., f.o.b., but to their disappointment the offer was declined, as the Commission had then the offer of 200,000 tons of the coming Mauritius crop at 90s., f.o.b., which, being so much under the Cuban offer, they accepted, and they then retired from the market. The Cubans held some 300,000 to 400,000 tons of unsold stock, for which they expected to obtain the high price then ruling, but they were disappointed to find that all their offers to American refiners were refused, and that they were being undersold by the flood of speculative sugars then arriving, and which, for financial reasons, had to be realized, and this only possible at a constant decline in values.

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It became a matter of serious consideration when it was found that at the end of July 16 cents were accepted for Cubans, which, from the highest point in May of 23½, established a fall of 46s. per cwt. From the same cause the downward course continued till October, when sales were made at 7 cents, the equivalent of 44s. 8d. per cwt., or at a decline of 93s. per cwt. from what was the highest point in May. This drastic fall was accompanied by very serious consequences to Cuba. Encouraged by the great prosperity which was being enjoyed by Cuba, many wealthy Americans had acquired estates in the island from which they hoped to obtain rich returns. Numerous centrals had also been enlarged, and machinery ordered for their thorough equipment. Other centrals were being re-modelled as refineries, to produce sugars fit for direct consumption, without having to pay toll to American refiners. Land was also being prepared for the erection of new centrals and refineries, but this unlooked-for decline in sugar sent a wave of depression all over the island, and for the time being stopped all operations. All classes of the Cuban people had likewise been indulging in luxurious and spendthrift habits, which involved large expenditure, and this, along with the depreciation of planters' unsold stocks, and speculative sugars over-advanced on by banks, led to widespread financial crises, and to the suspension of one bank. To avoid further disaster, President MENOCAJ felt compelled to arrange a moratorium to continue till 1st December.

It was not Cuba alone that was then a sufferer. American refiners, when compelled to purchase raw sugars at extreme prices, had prudently sold refined against them, but the loss on these sales of refined had become so ruinous that many buyers refused to implement their contracts. This gave rise to much anxiety, and as business in refined was for a time suspended, several large American refineries were closed until more settled market conditions again prevailed. Canada, likewise, came through the same trying experience, and all the refineries there have, for several weeks, been closed, awaiting such arrangements as will enable work to be re-commenced. Seven cents, however, which was the value of outside arrivals in America in October, could not be maintained, as the continuous importation of distressed sugars still further depressed the market, and on 15th December 3½ cents cost and freight came to be accepted. This has, so far, proved the lowest point, and since then sales of Cubans have been made at 4½ cents, or at the equivalent of 27s. 9d. per cwt., at 3·52 exchange, establishing a decline of 110s. per cwt. from the highest point.

Stocks of refined in both America and Canada have been so greatly reduced from numerous refineries having been closed that an active demand may be expected when they again resume work. Much trouble has likewise been experienced in Holland from speculators in Java sugars having failed to implement their contracts, and all the sugar world feels deep disappointment that their new crops are now coming on the market at a period of unlooked-for depression.

Cuba, with its fine climate and fertile soil, will doubtless soon again experience renewed prosperity. Its crop just commencing gives promise of being much greater than that of 3,730,000 tons now coming to a close, and as many planters had fortunately sold a considerable part of their crops in advance at 15 to 12 cents per lb. they have thereby secured a substantial profit.

The West Indian Crown Colonies show only an increase of 4000 tons over last year's production, but Jamaica has several new factories erected and in course of erection, and expects soon to have a yearly production of 100,000 tons. Some planters there have had much success during the past year in having realized their crops at £100 per ton, f.o.b., and in some cases at even above this figure.

Trinidad also looks for an increased production, as new land for this purpose has been acquired by several planters. The application of science to the successful prosecution of the sugar industry is now generally recognized, and it has been decided that a college for tropical investigation, with a model sugar factory and school, should be erected in Trinidad. Great benefit to all West Indian islands is expected from the institution of this college.

Barbados has been unfortunate in its crops of late, but it has nevertheless been prosperous, and can now afford to abolish its old windmills for grinding, and to substitute for them modern machinery.

Demerara continues to lag behind from the disastrous effects of droughts and insufficient supply of labour—Cuba, by its liberal treatment of workmen, having drawn them from Demerara and the West Indian Islands. Arrangements are now being made to increase the labour supply, and there is room for a large expansion of sugar production in this colony.

The Indigenous and Colonial Crops of America, which embrace Louisiana, Porto Rico, Hawaiian and Virgin Islands, also the Philippines, show only 180,000 tons of increase, but arrangements for expansion are now in progress. Great prosperity has been enjoyed by Hawaii and Porto Rico, and many estates on these islands have been able to declare dividends of 100 per cent. The Philippines are being equipped with ten new factories, and have room for great expansion. Hawaiian planters have been devoting part of their recently acquired wealth to the development of the Philippine sugar industry.

In the East *Java* and *Japan* have been enjoying prosperity notwithstanding several failures of speculators to implement their contracts.

Mauritius has been favoured with wonderful prosperity, and the Governor in recently opening the Legislative Council remarked, "that for its size, it is at present one of the wealthiest countries in the world. The prosperity of the sugar industry and of all connected with it has been phenomenal."

In *Australia* the sugar crop is under Government control, and by the Official Commissioners the limit for the present crop was fixed at £30 6s. 8d. per ton, f.o.b., basis 94 per cent., which price, although at the time much below the world's value, they considered quite satisfactory for all concerned. The present crop is estimated at 175,000 tons, but the next is expected to be largely increased. So rich were the canes of the 1919 crop that one ton of sugar was got from about eight tons of canes.

The United Kingdom.

The short price of raw sugars to the British refiners was fixed at 31s. till 22nd March, when it was raised to 41s., and continued thereat till 17th May, when it was again raised to 65s., at which it remained till 30th October, when it was reduced to 50s. 5d., remaining thereat till 29th November, when a further reduction took place to 35s. 11d., and latterly on 27th December the price was fixed at 28s. 4d.

British refiners have every reason to be grateful to the Royal Commission for having controlled their market during the past year, and for having relieved them of all difficulty in providing for their wants. Had they been uncontrolled, they might have shared the fate of the American and Canadian refiners, who have come through times of great hardship, anxiety and loss. It is hoped that this control may not be withdrawn till a more settled condition of markets prevails.

Government control still continues. For domestic consumption the price in January was 66s. for granulated and crystals, which held till 20th March, when it was advanced to 80s., and further, on 17th May, to 112s. This was the highest

The Sugar Trade during 1920.

point, and continued in force till 1st November, when there was a reduction to 96s., and the price was lowered on 29th November to 80s., and again on 27th December to 72s., at which it closes. The Royal Commission have supplied granulated sugars for domestic consumption at an average price for the year of 92s. 9d., which compares with an average of the prices of American sugar refiners of 16 cents per lb., or 97s. per cwt., taking an average rate of exchange of 3·70. The people of this country have, therefore, had a saving of 4s. 3d. per cwt. as compared with the people of the U.S., and in addition to this it should be borne in mind that the duty levied here is higher than the American duty, by about 18s. per cwt. At the close of the year the prices were 72s. per cwt., against 8 cents per lb., the Americans having meantime an advantage over us from the great decline which has recently taken place in that market.

Vegetable Decolorizing Carbons.

Factors which govern their Decolorizing Effect.

By A. B. BRADLEY.

In a previous communication,¹ the influence of such factors as temperature, size of carbon grain, time of contact, etc., was discussed, using "Norit" as the decolorizing agent. Stated briefly, the previous work showed that commercial decolorizing carbons are composed of fairly coarse to extremely fine particles in variable proportions, the decolorizing effect produced by these grades increasing rapidly as the size of particles diminishes up to a certain limit, that is, with carbon of such a size that it will pass through a 72-mesh sieve and be retained by an 84-mesh, after which the increase in efficiency slows down rapidly as the grain becomes still finer. This led the author to the conclusion that the very fine particles are not a desirable addition, especially when it is remembered that decolorizing carbons are very friable, the fine carbon therefore increasing constantly with use. When treating a 50 per cent. solution of raw Barbados sugar with increasing percentages of "Norit," it was found that, whereas the first 1 per cent. of carbon removed 62·5 per cent. of total colour, the decolorizing effect, after treatment with 4 per cent. of carbon, was only 83·5 per cent., and after treatment with 7 per cent., the total colour adsorbed was only 88 per cent. It was concluded from these results that the greater proportion of colouring matters in the sugar solution were in a crude colloid state of considerable molecular dimensions, and were thus the more easily removed, whereas the last traces of colour, being much nearer a true solution, were much more difficult to adsorb. The only advantage to be gained by using relatively large percentages of carbon was rapidity of filtration. The other conclusions from the previous work are not reiterated here, as they have no direct bearing on the present paper.

A number of decolorizing carbons have been recently examined, including a series very kindly sent by Dr. F. W. ZERRAN, late Research Chemist, Louisiana Sugar Experiment Station, also a sample of "Super-Filtchar" manufactured by the Industrial Chemical Co., New York. Many comparative experiments have been made with these carbons in the hope that, from the results so obtained, further light might be thrown on the problem of adsorption of colour, etc., by such carbons, it being remembered that samples showing identical chemical analyses give very different decolorizing effects, whilst often a more impure carbon gives the better result.

¹ *I.S.J.*, 1920, 52.

The carbons under examination were first tested for their comparative decolorizing efficiency, using a 50 per cent. solution of raw Jamaica sugar for all the tests. This solution was not cleared in any way, and contained, therefore, the colloid gummy matters natural to unfiltered sugar syrups. As in previous experiments, the carbon was added to the weight of sugar syrup to be used, just brought to the boil, and filtered through a 2½ in. Buchner funnel, using a pump suction equal to a pull of 26 in. of mercury. The colour estimations were made by means of a Lovibond tintometer. Table I gives the decolorizing effects obtained after treating equal bulks of the sugar solution with 5 per cent. of the respective carbons, together with the times taken for filtration. Column A gives the actual values obtained, and B the same values calculated on the basis of 100 for "Super-Filtchar."

Table I.

Carbon.	Colour adsorbed.		Comparative time for Filtration.				Ash. Per cent.		
	A.	B.	A.		B.				
			Min.	Sec.					
"Super-Filtchar"....	98.30	100.00	..	—	45	..	100.0	..	3.98
Z. 3	96.86	98.54	..	—	47	..	104.4	..	19.12
"Eponit"	95.00	96.64	..	1	26	..	191.1	..	7.40
Z. 152	92.43	94.02	..	1	—	..	133.3	..	0.50
"Norit"	90.00	91.56	..	1	32	..	204.4	..	6.99
Z. 150	89.57	91.12	..	1	22	..	182.2	..	3.53
Z. 20	86.86	88.36	..	2	40	..	355.5	..	2.82
Z. 134	82.90	84.33	..	1	33	..	206.6	..	25.67
Z. 51	57.86	58.86	..	2	6	..	280.0	..	5.86
Z. 142	57.00	57.98	..	19	8	..	2551.1	..	7.58

Carbons marked "Z" were supplied by Dr. ZERBAN. The numbers are the same as sent with them, and identify them as those examined by Dr. ZERBAN and his co-workers in their exhaustive research.¹

It will be noticed from the above table that working under the conditions stated, there is a decided tendency for slow filtration with samples giving low decolorizing effects. It might be mentioned that the moisture content of these samples varied only within the limits of 9-14 per cent. The percentage of mineral ash does not account for this variation in efficiency, as will be seen.

It is often stated that carbons of the greatest purity give the maximum decolorizing effects. As recently as August of this year BOCK² stated that "other conditions being equal, the material having the highest carbon content should give the best results." Although it is perfectly true that with any given sample an increase in efficiency does occur as the percentage of mineral matter contained in it is removed, it is, at the same time, quite possible to produce, in the laboratory, samples of extremely active carbons, which may then be adulterated with relatively large quantities of mineral matter (silica, etc.), and still be as efficient as most commercial carbons, if not more so. It is interesting to mention here that samples Z. 3 and Z. 142 illustrate this point particularly well. Both of the above samples were prepared from rice hulls ("Carbrox"³); sample 3 was prepared by Dr. ZERBAN, and 142 by Dr. H. S. SHILLSTONE, of New Orleans. Many tests were made in order to account for the differences obtained. Dr. SCHNELLER working on rice hulls carbon found that, when first retorted, this carbon contained 49 per cent. of mineral ash, and that the efficiency was only developed on the removal of the mineral matter. It would seem fairly obvious that the rapidity

¹ *La. Bulletin*, 167; *I.S.J.*, 1920, 90.

² *J. Amer. Chem. Soc.*, 1920, 42, 1864; *I.S.J.*, 1920, 708.

³ *I.S.J.*, 1920, 557.

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of filtration would also increase as a more porous carbon was produced. This worker found that a sample containing 43 per cent. of silica had a decolorizing efficiency of only 17 per cent. of that of "Norit." When, however, the mineral matter was reduced until only 18 per cent. remained, the efficiency of the sample had increased to 90 per cent. of that of "Norit," and finally, when 9 per cent. of ash only remained, he produced a carbon giving a decolorizing effect 45 per cent. better than that produced by "Norit" (which very seldom contains as much as 9 per cent. of mineral matter). Here, again, it is demonstrated that a carbon with a high ash value may still be more efficient than another sample which contains less ash. In these two examples of carbon prepared from the same raw material this holds good. ZERBAN, in the work previously mentioned,¹ has found that the period and degree of final roasting plays an important part in the production of highly active carbon. His results show that the higher the temperature, and the longer the period of the final roast, the more efficient the product. SCHNELLER² also found that to produce highly active carbon, the final heating must be carried to a bright red heat. COATES,³ in a similar manner, was able to produce a carbon from ordinary sawdust (without impregnating agents) equal in efficiency to "Norit" by prolonged heating at 1200°. As ashing and other tests have failed to produce any explanation which would account for the difference in efficiencies of samples Z. 3 and Z. 142, the only feasible conclusion one can arrive at is that these samples received very different heat treatments during preparation. (See later.)

ZERBAN determined the efficiency of some of the samples used in Table I in the following manner:—A solution containing 30 grms. per litre of a final molasses was prepared, and to 200 grm. lots of this solution 5 grms. of the different samples were added, just brought to the boil, and filtered through folded filters. The decolorizing effects were measured by means of the Hess-Ives tint-photo-meter. The following percentage decolorizing results were recorded:

<i>Table II.</i>	
Carbon No	Total Colour removed
152	89.0
"Norit"	81.0
150	84.0
20	99.4
51	76.0

The above results are tabulated in the order of efficiency found in Table I, and show some striking differences. It must be remembered that, whereas we work with a 50 per cent. solution, Dr. ZERBAN worked with roughly a 5-6 per cent. solution only.

Working with solutions of different strengths, the relative efficiencies of a number of samples of carbon may change. (See later.) We found (last communication) that the efficiency of a carbon decreases with an increase in concentration, with the same amount of colour present. ZERBAN noted first that sugar solutions contain several different colouring matters in varying proportions,⁴ and that vegetable carbons show selective adsorption. The values he found compared with Table I would seem to confirm this conclusion, but it will be shown later that this need not necessarily be the cause of such differences found, as it is possible that other factors come into play to cause these variations.

Having previously demonstrated that different sized grains from any one sample give increasingly efficient results as the size diminishes, up to a limit, after

¹ *I.S.J.*, 1920, 90.

² *I.S.J.*, 1918, 191.

³ *I.S.J.*, 1919, 619.

⁴ *I.S.J.*, 1919, 250.

which it remains nearly constant, it was thought interesting to grade some of the samples used in experiment No. 1 to see how the percentage composition, as regards size of particles, varies with the different decolorizing values obtained. It is a matter of regret that sufficient of each sample was not at hand to allow for the grading of all the samples. Table III gives the grading results obtained with five samples, the results of which taken with the decolorizing effects and times of filtration, become quite interesting.

Table III.

Sieve mesh per linear inch.	RESIDUE LEFT ON SIEVE, PER CENT.				
	"Filtchar."	Z. 3.	"Eponit."	"Norit."	Z. 142.
20	0.076 ..	— ..	0.02 ..	0.45 ..	1.00
28	0.298 ..	— ..	0.06 ..	0.41 ..	1.92
38	4.544 ..	0.178 ..	0.18 ..	0.45 ..	6.73
48	14.666 ..	2.010 ..	0.68 ..	4.64 ..	11.75
52	3.450 ..	1.88 ..	— ..	— ..	11.28
60	7.756 ..	13.81 ..	3.70 ..	7.30 ..	4.24
72	15.41 ..	10.34 ..	12.64 ..	12.80 ..	24.04
84	5.72 ..	2.88 ..	9.20 ..	7.61 ..	9.25
94	4.726 ..	7.398 ..	5.36 ..	6.96 ..	4.80
106	15.368 ..	15.616 ..	24.00 ..	6.43 ..	10.30
124	11.836 ..	19.80 ..	13.88 ..	4.60 ..	5.20
Passes 124 .. .	10.330 ..	26.176 ..	30.28 ..	49.20 ..	7.04
Decolorizing effect using 5 per cent.	98.3 ..	96.86 ..	95.00 ..	90.00 ..	57.00
Time of filtration..	min. sec. 0 45 ..	min. sec. 0 47 ..	min. sec. 1 26 ..	min. sec. 1 32 ..	min. sec. 19 8

It will be noted that the first four examples demonstrate that the greater the percentage of finest carbon (passing through meshes smaller than 84) the lower the decolorizing efficiency, and the longer the period of filtration. Here again Z. 142 does not fit into place. It would be expected from the grading results that this would be the most efficient sample. This is a technical point of some interest. From a purely scientific point of view one would expect the sample containing the highest percentage of "dust," presenting as it does a much larger surface area, to be the most efficient sample. The results on filtration as shown in the table, however, are clearly borne out in factory practice, when it is noticed that a much greater period is required to filter off batches of fine or disintegrated carbon, probably owing to the colloid gummy matters forming a semi-imperious layer with the finer grains.

It should be pointed out here that "Super-Filtchar" contains a fairly high percentage of carbon up to the 60 mesh sieve, but would not be expected to give filtration difficulty, owing to lack of bulk, on account of its physical structure, which is somewhat different from the average examples of vegetable decolorizing carbons. As a rule these carbons are obtained as a mass of intensely black, glistening specks, or splinters, whereas "Super-Filtchar" appears as a dull black porous-looking granular mass. On this account "Super-Filtchar" is bulky and forms an extremely good filtering medium, whereas many carbons, although fairly coarse, pack down owing to their physical structure and form less efficient filter cakes. At this stage it was thought advisable to see to what extent the bulk of a unit weight of the samples, or, as it is termed here, the "5 grm. volume," behaved towards the efficiencies found, and the times required for filtration. For the purposes of this determination, 5 grms. of each of the carbons under examination were weighed out, poured into a dry measuring cylinder, and gently tapped down for several minutes, after which the volumes were read off.

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The following values were thus obtained:—

Table IV.

VOLUME OF 5 GRMS. OF SAMPLE.			
Carbon.	Volume in c.c.	Carbon.	Volume in c.c.
"Super-Filtchar,"	40 c.c.	"Norit"	16 c.c.
Z. 150	30 "	Z. 20	16 "
Z. 3	26 "	Z. 142	14 "
Z. 134	23 "	Z. 51	14 "
"Eponit"	17 "		

If this table is examined in conjunction with No. III, it will be noticed that here again the samples follow a definite order, in that the carbons with the greatest 5 grm. volumes are found to correspond with the greatest decolorizing efficiencies, and with the most rapid rates of filtration, and *vice versa*. It is here also that the failure of carbon Z. 142 seems to be explained as the very low value found, together with the low ash value, means that this carbon is very dense, and, therefore, not sufficiently porous to give efficient results. It will be noticed that Z. 51 compares quite well with Z. 142 both for volume and efficiency. It must be remembered, however, that the higher the volume found, the more friable the sample must be, therefore in factory practice it is quite possible that some of the carbons examined would break down very quickly. WEINRICH¹ has stated that the decolorizing power of char should be determined by volume rather than by weight, and that equal volumes of various carbons have the same decolorizing power. It was thought that perhaps this theory was correct from the results obtained from the above different volumes of carbon for a common weight. For the examination of this point, several of the carbons were graded, and the residues left on the 106 sieve were taken for test, 5 grms. being weighed out and measured for volume as before. It was found that the values followed the order of efficiency, and, therefore, that a decrease in volume was not due to a high percentage of dust packing down, but to low porosity, and bulk of the sample. Equal volumes of these carbons (5 c.c.) were now added to 100 c.c. lots of a raw cane sugar solution, and treated as in previous experiments. Table V gives the volumes obtained from a unit weight of each sample of the same grain size, together with the decolorizing values of the various carbons.

Table V.

	Volume of 5 grms. of sample	Decolorizing effect from 5 c.c. of sample
"Super-Filtchar"	32 c.c.	81.13 per cent.
Z 3	28 c.c.	81.17 per cent.
"Norit"	15 c.c.	80.00 per cent.
Z. 51.	14 c.c.	63.40 per cent.

These figures would seem to show that the statement "equal efficiencies for equal volumes of carbons" is not true, and would, in the author's opinion, show that the relative efficiency of any sample is dependent chiefly on its porosity, or bulk, although the size of grain also plays a part.

Having now obtained the efficiency of each sample, the rate of filtration, volume, etc., it was suggested to exhaust thoroughly the samples by successive treatment with four batches of syrup. For these tests, 5 grms. of each of the samples were added to 200 grm. lots of raw sugar syrup, boiled and filtered as before, and then the pressed carbon cakes again added to fresh lots of sugar syrup until four successive batches of syrup had been treated. The decolorizing effects and times required for filtration are given in Table VI, where column A gives the actual values obtained, and column B the percentage results calculated on the basis of 100 for "Super-Filtchar."

¹ I.S.J., 1917, 408.

Table VI.

DECOLORIZING RESULTS.

Carbon	1st Batch		2nd Batch		3rd Batch		4th Batch	
	A	B	A	B	A	B	A	B
"Filtchar" ..	98.30	100.00	95.86	96.50	91.00	92.57	88.57	90.10
Z.3. ..	96.86	98.54	92.43	94.02	91.57	93.15	90.43	91.99
Z.150 ..	89.57	91.12	72.57	73.82	59.70	60.73	56.00	56.96
"Eponit"	95.00	96.64	91.43	93.00	87.00	88.50	81.00	82.40
"Norit" ..	90.00	91.56	88.57	90.10	79.70	81.07	72.57	73.82

TIME REQUIRED FOR FILTRATION.

	m. s.		m. s.		m. s.		m. s.	
"Filtchar" ..	45	100.0	2 35	344.4	3 30	466.6	5 45	766.6
Z.3. ..	47	104.0	2 35	344.4	5 45	755.6	6 50	911.1
Z.150 ..	1 22	182.2	3 10	422.2	7 45	1033.3	10 10	1365.5
"Eponit"	1 26	191.1	2 25	322.2	4 20	577.7	10 10	1365.5
"Norit" ..	1 32	204.4	5 25	722.2	13 0	1733.0	over	over
							1 hr.	.8 000

Table VI demonstrates that carbons which contain the highest percentage of fine carbon choke up first, and give low final results, the times taken for filtration also increasing greatly after the second treatment. Next, carbons that contain little fine carbon, but moderate amounts of large grain, hold up well until after the second treatment, when the efficiency seems to drop rather rapidly. Carbons of medium grain give proportionally the best decolorizing results, although the time required for filtration is somewhat greater than that of the second class. It is fairly obvious also that here again the specific volume of the carbon must influence the efficiency and rate of filtration, the latter being very marked when filtering the last three on the list, during the third and fourth treatments. If the grading percentages found with the different carbons are graphed against the sieve mesh, it will be noticed that the crossing points agree fairly closely with the order in which the carbons change their relative efficiencies.

Experiments were next made to see if the relative efficiencies remained constant during the treatment of several kinds of raw sugar. For these tests, three different raw sugars were treated with the decolorizing carbons, using $2\frac{1}{2}$ per cent. of carbon on two examples and 5 per cent. of carbon on the third. Table VII gives the relative decolorizing effects produced, together with the times required for filtration. Column A gives the actual values obtained, and column B the same calculated on the basis of 100 for "Super-Filtchar."

These last figures show that with 5 per cent. of carbon such as "Super-Filtchar," much better results are obtained than with the other examples, owing to the size of grain and the volume. When, however, a much smaller percentage of carbon is used, the relative efficiency of the carbon containing the finer grades increases, the periods of filtration being also somewhat more rapid. In the case of the S.M.S. Co.'s carbon, however, the reverse action is noticeable. This is a technical point of interest; it shows that for light or semi-refined sugars, where a small percentage only of carbon is added, better results would be obtained by the employment of fine grained carbons than coarse varieties, whereas in the case of raw or fairly gummy sugars, if not cleared before treatment, maximum results are obtained with carbons as free as possible from either excessively large or very fine grain. This fact becomes of even greater interest when it is remembered that decolorizing carbons (being very friable) disintegrate with continued use, and suggests to the sugar refiner the use of the older batches of carbon for the treatment of light or washed sugars, with the employment of new, or lesser used, batches of carbon for the treatment of dark or more gummy grades of sugar.

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Table VII.

CARBON	DECOLORIZING EFFECTS PRODUCED					
	JAMAICA SUGAR. 5 per cent. carbon used.		DEMERARA SUGAR 2½ per cent. carbon used.		BARBADOS SUGAR. 2½ per cent. carbon used.	
	A.	B.	A.	B.	A.	B.
"Filtchar"	98.3 ..	100.00 ..	72.48 ..	100.00 ..	63.75 ..	100.00 ..
Z. 3	96.86 ..	98.54 ..	82.40 ..	113.60 ..	72.38 ..	113.50 ..
*S.M.S. Co.....	89.30 ..	90.85 ..	41.76 ..	71.45 ..	53.75 ..	84.30 ..
"Norit"	90.00 ..	91.56 ..	66.40 ..	91.62 ..	58.75 ..	92.14 ..

	TIMES OF FILTRATION.					
	min. sec.		min. sec.		min. sec.	
"Filtchar"	0 45 ..	100.00 ..	2 15 ..	100.00 ..	2 15 ..	100.00 ..
Z. 3	0 47 ..	104.40 ..	2 15 ..	100.00 ..	2 20 ..	103.70 ..
*S.M.S. Co.....	19 40 ..	2622.00 ..	49 40 ..	2177.70 ..	56 18 ..	2500.00 ..
"Norit"	1 32 ..	204.44 ..	4 29 ..	199.60 ..	3 50 ..	170.30 ..

It is interesting to record the fact that when the sample of S.M.S. Co's. carbon was crushed in a mortar, decolorizing effects very similar to those given with "Norit," were obtained.¹ The addition of a small percentage of coarse carbon such as this to very fine batches of carbon might be recommended in order to maintain an open or porous carbon cake, and facilitate filtration.

Conclusions.—(1) The results obtained by treating a 50 per cent. raw Jamaica sugar syrup with various carbons, using 5 per cent. on the weight of sugar taken, show that the greatest decolorizing effect is produced with carbons giving the quickest rate of filtration.

(2) The activity of a vegetable decolorizing carbon is not dependent upon the percentage of carbon present.

(3) Of the various samples of carbon examined, those containing the greatest percentage of the finest grades gave most trouble during filtration, as well as giving the lowest decolorizing results, under the conditions stated in (1).

(4) The volume, or bulk of the carbon for a common weight affects the rate of filtration, and decolorizing effect. Carbons giving the greatest bulks are most efficient if used under conditions stated below. In other words, the more porous the carbon the greater the decolorizing effect, and more rapid the filtration. The specific volume is not entirely dependent upon the composition of the sample as regards size of grain, similar sized grains of different carbons (weight for weight) following the order of the volumes found for the samples containing variable percentages of the different grades.

(5) Equal volumes of different samples of decolorizing carbon of the same grain size do not give similar decolorizing effects, the efficiency being influenced by the porosity of the sample.

(6) Decolorizing carbons, if used for treating successive batches of sugar syrup, without revivification, seem to choke up, first according to the amount of dust they contain, and finally according to the percentage of large grain. Samples containing the maximum quantity of medium grain (say 84 to 106 mesh) hold up best.

(7) Carbons containing high percentages of the finest grades give better results when used on semi-refined, washed, or good quality raw sugars, than do larger sized carbons. On the other hand when treating raw sugars which are inclined to be gummy, better results are obtained with carbons as free as possible

* A sample of very coarse carbon prepared by the Sugar Manufacturers' Supply Co., Ltd.

¹ The S.M.S. Co.'s carbon is also sold in this finely ground grade.

from dust, and which are of a uniform medium grain. Large-grained carbons are not efficient either from their decolorizing effect or rate of filtration, unless much larger quantities than 5 per cent. are used.

The writer's thanks are due to Dr. F. W. ZERBAN for the supply of most of the samples of carbon used in this work, to Capt. R. WHYMPER, M.C., for his very kind suggestions and advice, and to Messrs. Peek Frean & Co., in whose laboratories this work was carried out.

Relative Importance of some Colouring Matters in Cane Juices and Syrups.¹

By F. W. ZERBAN.

We have found that the colour of raw cane juice is largely determined by three factors, viz., the presence of tannin, iron salts, and oxidizing enzymes.² A juice may exhibit all the different shades between brown and green, according to the proportion of tannin and iron it contains; but its colour is further affected by the water-soluble colouring matters of the rind of the cane, which are also polyphenols in the wider sense, belonging to the anthocyanin group. Mill juice from purple canes may be 50 per cent. darker than that from green canes.

Ferric polyphenol compounds play a very important part in the colour of our products; but the question still remains how much of the total colour is due to them, and how much to: (1) the colouring matters of the rind, belonging to the anthocyanin and chlorophyll groups; (2) the incrustating colouring matter termed "saccharetin" by Steuerwald³ (a polyphenol derivative); and (3) products formed by the decomposition of sugars under the influence of heat alone or by the effect of alkali especially in the presence of amino-acids.⁴

Practically nothing has been ascertained concerning the exact extent to which each of these groups contributes to the colour of sugar-house products. HARLOFF⁵ recently pointed out that the acid thin-juice process with heavy sulphitation of the syrup prevents the iron contained in the massecuite from entering the crystals, thus avoiding the production of the dark colour caused by ferric polyphenol compounds. But the molasses obtained by this process is certainly unfit for human consumption, and for this reason the process mentioned would not help the solution of the problem in Louisiana, where the object is to obtain the largest amount of white sugar and such a quantity of high-grade molasses that the combined output will bring the largest financial return. In order to do this, we must not merely prevent the presence of iron in the sugar, but must decrease both iron and all colouring matters in the massecuite to the lowest possible point.

It therefore becomes a necessity to have an exact knowledge of the nature and proportions of the various factors contributing to the colour of the products. A series of five artificial raw juices were therefore prepared, each of which contained 12 per cent. of sucrose, and in addition: (1) enough acetic acid (the principal acid of cane) to bring the acidity to 0.015 N; (2) 2.1 per cent. of reducing sugars; (3) 0.067 per cent. asparagin, exactly neutralized with potassium hydroxide; (4) the same amount of asparagin with 0.133 per cent. of aspartic acid, also neutralized with potassium hydroxide (the sum of these compounds representing the quantity

¹ Editorial summary of a paper presented to the 56th meeting of the American Chemical Society, Philadelphia; *J. Ind. Eng. Chem.*, 1920, 12, No. 8, 744-751.

² *I.S.J.*, 1918, 561; 1919, 180.

³ *I.S.J.*, 1912, 53.

⁴ *I.S.J.*, 1914, 184, 230; 1915, 234.

⁵ *I.S.J.*, 1919, 574.

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of protein cleavage products occurring in cane juices); and (5) in addition to the previous constituents, a quantity of iron-greening tannin prepared from cane, corresponding to 0.0167 per cent. of gallo-tannic acid.

These artificial ~~new~~ juices were clarified by five different methods, viz., (1) sulphiting in the cold to an acidity of 0.06 N was reached, and at once liming back to an acidity of 0.01 N (which process is quite generally employed in white sugar manufacture in Louisiana); (2) sulphiting to 0.06 N acidity, and liming back to 0.002-0.003 N acidity; (3) sulphiting to 0.06 N acidity, and treating with lime to an alkalinity of 0.002-0.003 N (which was done to study the effect of a slight excess of lime in the presence of sulphites); (4) liming to an acidity of 0.002-0.003; and (5) liming to an alkalinity of 0.002-0.003 N. After these treatments, the juice was boiled and filtered (water being added to make up for evaporation); and in each case part was concentrated under a partial vacuum at about 70°C, being finally made up to the original volume. Thus 25 "runs" were made, but all of these were repeated adding 0.002 per cent. of iron in the form of ferric chloride. Lastly, each product on the five series of tests was subjected to the ordinary sugar-house analysis, besides which the total depth of colour was measured by the Hess-Ives tint-photometer, and the following were the results obtained.

In Series I (sucrose alone) practically no colour was formed in any of the methods of clarification, whether iron was present or not. The more lime added to the sulphured juice, the more iron was precipitated; and clarification with lime alone to slight acidity removed the iron practically completely. When, however, the lime was added to slight alkalinity, a little iron remained dissolved without noticeable effect on the colour.

In Series II, when no iron was added, there was practically no colour formed as long as the juice was still acid after liming, but when the lime was added to alkalinity there was a little colour. On concentrating to syrup, in the presence of sulphites the colour did not increase, but even became less. When lime alone was used, the colour increased over three-fold from juice to syrup. In the presence of iron, colour formation was more pronounced. Clarified juice obtained by sulphuring and liming to slight acidity had 0.5° of colour (Hess-Ives), which did not increase appreciably on boiling to syrup. When the raw juice was sulphured and limed to alkalinity, 0.9° was developed, and this became 2.1° in the syrup. But with clarification with lime alone to alkalinity, the juice showed 2.6°, increasing to 7.0° in the syrup, which gave a slight reaction for polyphenols. This reaction was probably due to a decomposition of glucinic acid primarily formed, which according to FERNAND GAUD¹ may split up into pyrocatechol and gluconic acid. Glucinic acid itself gives an iron reaction, not Allen's polyphenol reaction, but one probably due to its nature as a polyoxy-acid, which may be intensified by pyrocatechol formed secondarily.

Series III and IV showed that the effect of the very limited amounts of acid amides and amino-acids is not very great. As long as the juice after liming is still acid, the colour developed is no greater in the presence of these compounds than in their absence. It is noteworthy, however, that in the syrup obtained in Series III (asparagin alone) by Method 5 (liming to an alkalinity of 0.002-0.003 N) a slight reaction for polyphenols was again obtained; while such positive reactions were even more numerous in Series IV (asparagin and aspartic acid). These findings are quite in accord with the results of MAILLARD² and of STOLZENBERG³, who

¹ *Sucr. Ind. Colon*; 1894, 44, 482.

² *Comptes rendus*, 1911, 153, 1078; 1912, 154, 66; *I.S.J.*, 1914, 184

³ *Berichte*, 1916, 20, 2021.

showed that the nitrogenous colouring matters formed from amino-acids and reducing sugars' have a cyclic structure and contain hydroxyl groups. Here we evidently have to do with true polyphenols, but their iron compounds are not as dark as those with tannin.

So far it has been shown that in the method of clarification used in white sugar manufacture in Louisiana, in which the juice is strongly sulphured and limed back to decided litmus acidity, any decomposition products of glucose formed, even in the presence of amino acids, amides, and iron, do not produce any considerable colour under normal conditions of working. The large amount of colouring matter which we actually do find in the clarified juice and syrup made by this process in the factory must, therefore, be almost entirely due to other causes.

In Series V, in addition to the constituents used in Series I to IV, a small quantity of the iron-greening tannin isolated from the cane was added. This produced a remarkable effect on the colour of all the products, more especially in the presence of iron.

Taking first the artificial raw juice in the absence of iron, there is quite a perceptible amount of colour, due to a slight oxidation of the tannin taking place soon after it is dissolved.

In the case of clarified juices in the absence of iron, the important observation is made that the clarification methods themselves bring about formation of colouring matter from the tannin, although a part of this latter was removed. Method 3 removed the largest quantity of tannin, Method 2 less, and Method 1 the least of those using lime and sulphur; but in the two methods of clarification without sulphur the colour is much darker, once more proving the bleaching effect of the sulphites and sulphurous acid. However, during evaporation from clarified juice to syrup, the increase of colour was least in Method 1, more in Method 2, and most in Method 3, probably owing to the more effective bleaching effect of sulphites at the higher acidity.

Turning now to the test carried out in the presence of both the tannin and iron, it was apparent immediately that very dark-coloured products were formed. A comparison of the natural juices with these artificial ones made with tannin, shows that this polyphenol compound is only partly responsible for the colour of raw cane juice. The oxidation products of this tannin by oxidases, as well as the anthocyanins of the rind and the "saccharetin" of the fibre, evidently play an important part, both of which colouring matters belong to the polyphenols.

The juices containing tannin and iron on being clarified behaved somewhat differently from those without iron. While it was found true that all the clarified juices are again much darker than the raw juices, the colour of the former does not decrease from Method 1 to Method 3, but slightly increases. This is probably due not so much to an increase in polyphenol compounds as to the fact that the colour of the iron polyphenol compounds increases with decreasing acidity. Methods 4 and 5 using lime alone produced much darker juices than did lime and sulphur, owing to the absence of the bleaching effect of the sulphites. Between the stages of juice and syrup, there was little increase of colour in this series, once more showing that the decomposition products of glucose by heat, even in the presence of excess of alkali and amino-acids, have no great effect on the colour.

Some very important deductions may be drawn from the results obtained so far. Our factory tests of last year, and these now reported, have clearly demonstrated that in the presence of polyphenol compounds and their derivatives, and at the same time of iron salts, the chemical methods of juice purification practised

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in Louisiana (even sulphitation with high final acidity) produce clarified juices which are not lighter but often even appreciably darker than the raw juices from which they are obtained. Our methods of purification do not bring about an improvement, but rather a decrease in the quality of the juice, and do not effect what according to PRINSEN GEERLIGS is the principal object of clarification, namely the removal of colouring matter and other colloidal impurities. It is becoming more and more clear that the solution of the problem will have to be sought along the lines of colloid chemistry, as pointed out by БЭК¹ and by others. It is true that the precipitates produced by the chemical methods now in vogue in Louisiana tend to carry down some of the coarser dispersoids of cane juice, but they are very inefficient in this respect.

This brings us then to the question of removing not only coarse dispersoids, but colloids as well. It seems certain that what is done so imperfectly now by the precipitates produced through the addition of chemicals to the juices can probably be accomplished much better by physical adsorption. It is known that certain forms of carbon, especially the so-called decolorizing carbons, are under certain conditions very effective in removing colloids. There may be yet other ways, based on principles of colloid chemistry, which might lead to success. The feasibility of the use of decolorizing carbons for the purpose in hand has already been amply demonstrated; but the economical side of the problem still remains to be worked out in detail.

The Analysis of Sugar Mixtures containing Two Monosaccharides.

By C. A. BROWNE.

The first reference to a combination of polarimetric and copper reduction methods for analysing a mixture of two reducing sugars was probably made by APJOHN² in a paper entitled "A new Step in the Proximate Analysis of Saccharine Mixtures," read before the Royal Irish Academy on December 13th, 1869. APJOHN stated that the principle of this method was due to a suggestion given him by JELLETT, the eminent physicist of Trinity College, Dublin, who is best known for the polarizing prism which bears his name.

Immediate after Apjohn's contribution, DUPRÉ³ published a paper upon the "Estimation of Three Kinds of Sugar in one Solution," in which he describes a similar combined procedure that had been used by him for several years and which involved less calculation than that of APJOHN. The formulas of DUPRÉ for a mixture of what he terms grape sugar and fruit sugar are $x + y = p$, the sum of the sugars found by copper reduction, and $1.502x - 0.836y = a$, the sum of the rotations of the two sugars. The values 1.502 and -0.836 are given as the rotations respectively of grape and fruit sugar expressed in inches, these measurements and that of the quantity a being determined no doubt by Jellet's telescopic compensating tube.

Following APJOHN and DUPRÉ, other chemists made contributions from time to time upon this subject, as for example NEUBAUER⁴ in 1877 (to whom the credit for this method of analysis is often wrongly ascribed), SEYDA and WOY⁵ in 1896,

¹ *I.S.J.*, 1919, 70; see also DEERE, *I.S.J.*, 1916, 502, 558.

² *Transactions Royal Irish Academy*, 24, 581; *Chem. News*, 1870, 21, 86.

³ *Chem. News*, 1870, 21, 97.

⁴ *Berichte der deut. chem. Ges.*, 10, 827.

⁵ *Zett. angew. Chem.*, 1896, 286.

and ROCQUES¹ in 1900. All these authors, as LIPPMAN² has pointed out, based their calculations upon the false assumption that the two sugars in the mixture have the same reducing power with the consequence that the final results are more or less in error.

In 1906 the writer³ proposed as a more accurate solution of the problem, the employment of reduction ratios which are based upon the principle that the weights of two reducing sugars bear a constant ratio to one another for the same weight of reduced copper, when the reductions are performed under exactly similar conditions. The general formulas proposed for this method of determining two reducing sugars *A* and *B* in mixture are: $x = \frac{bP - \beta R}{\alpha b - a\beta}$ and $y = \frac{R - ax}{b}$ in which *x*, *a*, and α are respectively the percentage, copper reducing ratio (in terms of dextrose) and specific rotation of sugar *A* and *y*, *b* and β the same of sugar *B*, and *R* the total reducing sugar as dextrose.

The ratios between the weights of two sugars for the same weight of reduced copper vary slightly according to methods of reduction and also differ somewhat at the beginning of the tables where only small amounts of sugar are present to be acted upon. The constancy of the ratios for several sugars according to different methods of reduction may be seen from the following examples.

Allihn's Method.

Reduced Copper. Mgrms.	Dextrose (<i>d</i>). Mgrms.	Levulose (<i>l</i>). Mgrms.	Ratio $\frac{d}{l}$ Mgrms.	Galactose (<i>g</i>). Mgrms.	Ratio $\frac{d}{g}$ Mgrms.
86.7	44.3	48.9	0.906	50.0	0.886
177.2	90.6	99.1	0.914	100.0	0.906
210.1	108.0	117.8	0.916	120.0	0.900
259.5	134.4	146.6	0.916	150.0	0.896
309.6	161.8	176.5	0.916	180.0	0.899
340.8	179.2	195.6	0.916	200.0	0.896
372.3	197.0	215.2	0.915	220.0	0.896
422.3	225.9	247.1	0.914	250.0	0.904
Average			0.915	—	0.898

It is seen that for amounts of reducing sugars between 50 and 250 mgrms. the reducing ratios of dextrose, levulose and galactose are very constant. As an example of the ratios for very small amounts of reducing sugar, the following examples for dextrose and levulose are given:—

Allihn's Method.

Reduced Copper. Mgrms.	Dextrose (<i>d</i>). Mgrms.	Levulose (<i>l</i>). Mgrms.	Ratio $\frac{d}{l}$ Mgrms.
13.7	7.9	10	0.790
32.7	17.4	20	0.870
51.5	26.6	30	0.887
70.2	35.9	40	0.898
88.7	45.3	50	0.906

The reducing ratios do not become constant until about 50 mgrms. of sugar are present. The variable ratio for small amounts of sugar may be due to a difference in the initial speed of reduction for the various sugars, but it is also probably dependent upon the fact that the copper reduced by the first quantities of one sugar is in a more colloidal condition than that reduced by another. As soon as the

¹ *Ann. chim. anal. appl.*, 5, 216.

² "Chemie der Zuckerarten." 1904, Vol. 1, page 898.

³ *J. Amer. Chem. Soc.*, 1906, 28, 439.

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reduced copper reaches a certain maximum, the colloidal particles which escape filtration are mostly precipitated and the reducing ratio then becomes constant.

For purposes of analysis only the constant reducing ratio should be taken. This does not appreciably affect the accuracy of the method, when only small amounts of sugar are present, as the errors of calculation are correspondingly reduced.

The following examples are given for Kjeldahl's method of copper reduction, according to the tables of Woy :—

<i>Kjeldahl's Method.</i>							
Reduced Copper. Mgrms.	Dextrose (d). Mgrms.	Levulose (l). Mgrms.	Ratio $\frac{d}{l}$ Mgrms.	Galactose (g). Mgrms.	Ratio $\frac{d}{g}$ Mgrms.	Maltose (m). Mgrms.	Ratio $\frac{d}{m}$ Mgrms.
107.0 ..	48.0 ..	52.7 ..	0.911 ..	53.1 ..	0.904 ..	88.8 ..	0.540 ..
136.6 ..	62.0 ..	68.1 ..	0.910 ..	68.5 ..	0.905 ..	114.1 ..	0.543 ..
154.9 ..	71.0 ..	77.8 ..	0.913 ..	78.3 ..	0.907 ..	129.9 ..	0.546 ..
194.9 ..	91.0 ..	99.5 ..	0.915 ..	100.2 ..	0.908 ..	164.9 ..	0.552 ..
237.2 ..	113.0 ..	123.3 ..	0.916 ..	124.0 ..	0.911 ..	202.7 ..	0.557 ..
277.1 ..	135.0 ..	146.7 ..	0.920 ..	147.6 ..	0.915 ..	239.0 ..	0.565 ..
317.0 ..	158.0 ..	170.9 ..	0.926 ..	172.1 ..	0.918 ..	276.2 ..	0.572 ..
353.0 ..	180.0 ..	193.8 ..	0.929 ..	195.2 ..	0.922 ..	310.3 ..	0.580 ..
394.5 ..	207.0 ..	221.6 ..	0.934 ..	223.3 ..	0.927 ..	350.6 ..	0.590 ..
423.3 ..	227.0 ..	241.7 ..	0.939 ..	243.6 ..	0.932 ..	379.1 ..	0.599 ..
Average			0.921 ..	— ..	0.915 ..	— ..	0.562 ..

The table shows a greater susceptibility of maltose towards decomposition with increasing amounts, the quantity of sugar necessary to reduce a given amount of copper becoming less and the reducing ratio as compared with dextrose becoming more. This observation is also true of lactose. The errors of reducing sugars in mixtures are therefore greater when disaccharides are present.

The average reduction ratios of dextrose, levulose and galactose show a very close agreement between Allihn's and Kjeldahl's methods. The ratios obtained by Allihn's method seem to show upon the whole a greater uniformity between 50 and 250 mgrms. than those obtained by the Kjeldahl and other methods of reduction which the author has studied. It is for this reason that he has preferred the Allihn method in the analysis of sugar mixtures.

A. W. VAN DER HAAR,¹ in a recent work upon the identification and estimation of monosaccharides, criticizes the general principle of the writer's method for analysing sugar mixtures on the ground that the reduction ratios of the sugars are not exactly constant. VAN DER HAAR remarks, however, that this lack of constancy is of little or no consequence in actual work as the variations from the mean ratio are not large enough to cause a serious error in the calculation.

Van der Haar's objection to the principle of constant reducing ratio is based chiefly upon the results with small quantities of sugar, the abnormal action of which upon Fehling's copper solution has already been discussed. The writer would criticize, therefore, Van der Haar's method of determining reducing ratios by averaging the two extremes, as he has done in the case of Schoorl's tables, instead of averaging the ratios taken at regular intervals as in the previous examples. The reducing ratios of several monosaccharides for Schoorl's volumetric copper reduction method have been calculated by the writer with the following results :—

¹ "Anleitung zum Nachweis, zur Trennung und Bestimmung der reinen und aus Glukose usw. erhaltenen Monosaccharide und Aldehydsäuren." Berlin, 1920. Page 133.

Schoorl's Method.

c.c. N/10	Dex- thio.	trose (d). Mgrms.	Levu- lose (d). Mgrms.	Ratio	$\frac{d}{l}$	Galac- tose (g). Mgrms.	Ratio	$\frac{d}{g}$	Arabin- ose (a). Mgrms.	Ratio	$\frac{d}{a}$	Xylose (x). Mgrms.	Ratio	$\frac{d}{x}$
1	..	3.2	..	3.2	..	1.000	..	3.3	..	0.970	..	3.0	..	1.067
3	..	9.4	..	9.7	..	0.969	..	10.4	..	0.904	..	9.2	..	1.022
5	..	15.9	..	16.4	..	0.969	..	17.5	..	0.909	..	15.5	..	1.026
8	..	25.6	..	27.4	..	0.934	..	28.3	..	0.905	..	25.2	..	1.016
10	..	32.3	..	34.9	..	0.926	..	35.7	..	0.905	..	32.0	..	1.009
12	..	39.0	..	42.4	..	0.920	..	43.1	..	0.905	..	38.8	..	1.005
15	..	49.3	..	53.7	..	0.918	..	54.3	..	0.908	..	49.0	..	1.006
18	..	59.8	..	65.0	..	0.920	..	65.7	..	0.910	..	59.3	..	1.008
20	..	66.9	..	72.4	..	0.924	..	73.4	..	0.911	..	66.5	..	1.006
22	..	74.5	..	80.1	..	0.930	..	81.2	..	0.917	..	74.0	..	1.007
25	..	86.6	..	91.7	..	0.944	..	93.0	..	0.931	..	85.7	..	1.011
Average (omitting 2).. 0.936 .. — .. 0.911 .. — .. 1.012 .. — .. 0.975														

Van der Haar's averages of the extreme ratios for 1 c.c. and 25 c.c. of $\frac{n}{10}$ thio-sulphate, in the same order as given above, are respectively 0.972, 0.950, 1.039 and 1.000, which values it will be noted are far less concordant with the actual ratios of the table, than the ratios calculated by the writer. The reducing ratios of the four sugars as thus calculated are also in very good agreement with those found for Allihn's method.

Reducing Rates as compared with Dextrose.

	Levulose.	Galactose.	Arabinose.	Xylose.
By Allihn's method ..	0.915	0.898	1.032	0.983
By Schoorl's ..	0.936	0.911	1.012	0.975
By Kjeldahl's ..	0.921	0.915		

The employment of reducing ratios in the analysis of sugar mixtures containing two monosaccharides may therefore be considered reliable for any of the ordinary methods of copper reduction with Fehling's solution. The ratios found for one method of reduction seem, at least so far as determined, to be applicable without serious error to other methods of reduction. The safest policy, however, is for the analyst to establish his own ratios for the particular method desired. The volumetric method of SCHOORL, which VAN DER HAAR prefers for reasons of simplicity and speed, is adapted only for quantities of sugar below 90 mgrms. This method has, therefore, the objection that a greater dilution and multiplication of error are involved, when large amounts of sugar are present, than with Allihn's method which is adapted to weights of glucose as high as 250 mgrms.

The accuracy of this method of analysis when applied to sugar mixtures containing known amounts of two monosaccharides has been shown by examples in the writer's original paper, and does not require additional illustration at this time.

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Report has it that the sugar gamble of 1920 led to one group of refiners in America making £2,000,000 in the earlier months of that year, and losing £8,000,000 in the later months. This net loss was said to be more than the whole capital sum invested in the refineries.

Determination of Lime Salts in Juices by Means of a Standard Soap Solution.

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The determination of lime (CaO) and magnesia (MgO) in sugar-house products is of utmost importance, because if considerable quantities of their salts be present scaling in the evaporators and heaters occurs, necessitating the cleaning of the apparatus during the grinding season.

For this determination a soap solution is used. The solution is prepared of such strength that 1 c.c. corresponds to 0.001 gm. CaO . A barium chloride solution of this strength is prepared as follows:—

Dissolve 4.3570 grms. of $\text{BaCl}_2 + 2 \text{H}_2\text{O}$ with distilled water. If pure barium chloride is not available, prepare a cold saturated solution of the salt on hand and add double the volume of hydrochloric acid; collect the crystals on a filter, and wash with 90 per cent. alcohol until free from acid. Dry between filter-paper or blotting paper, but without application of heat. Take the given amount of this pure salt and make up to a litre with distilled water.

The soap solution is prepared from pure Castile soap, though the writer has used a liquid soap of high purity and obtained just as good results. In using the Castile soap, 25 grms. of the soap shavings are dissolved in 60 per cent. alcohol and made up to a litre. This solution will be slightly too strong.

We now take 10 c.c. of the barium chloride solution in a 4 oz. oil-sample bottle and complete the volume to 50 c.c. with distilled water.

From a burette add slowly small portions of the soap solution, shaking violently after each addition. A milky white precipitate of a barium soap is at first formed, but when sufficient soap has been added to react with all the barium chloride, a slight excess of soap will produce a fine bubbled foam. Sufficient soap to produce a foam 1 in. high that will remain 5 minutes is added.

As the soap is to be of such strength that 1 c.c. equals 0.001 gm. CaO , and 10 c.c. of barium chloride solution, each c.c. of which is equal to 0.001 gm. CaO , were used, it is apparent that 10 c.c. of soap solution will be necessary if the soap solution is of correct strength. There is, however, one thing to be considered here—it requires approximately 0.5 c.c. of soap to produce foam on 50 c.c. distilled water such as is obtainable ordinarily with the laboratory still. Therefore, we must make our soap of such a strength that 10.5 c.c. will exactly produce the end-reaction with the 10 c.c. of barium chloride, and always use 50 c.c. for tests.

From a series of tests it was found that 9.5 c.c. of soap brought about the desired end-reaction with the 10 c.c. of barium chloride, whereas it should have taken 10.5 c.c. This shows that the soap is too strong. The dilution is calculated as follows:—

$$9.5 : 10.5 :: x : 1000 \therefore x = 904.7 \text{ c.c.},$$

which amount made up to 1 litre with 60 per cent. alcohol will give a solution of the desired strength.

In acid juices the exact acidity must be determined by titration with an alkali solution of known strength, and sufficient ammonium hydroxide solution added to exactly neutralize the acid present.

For a matter of comparison all results are reported to 100° Brix. Using 20 c.c. of thin-juice made up to 50 c.c. with distilled water, the following formula

TABLE No. I.

THIN JUICES.

Number of c.c. of Soap Solution.

Brix.	1	2	3	4	5	6	7	8	9	10
8.0 ..	0.061 ..	0.121 ..	0.182 ..	0.242 ..	0.303 ..	0.364 ..	0.424 ..	0.485 ..	0.545 ..	0.606 ..
8.2 ..	0.069 ..	0.118 ..	0.177 ..	0.236 ..	0.295 ..	0.354 ..	0.413 ..	0.472 ..	0.531 ..	0.590 ..
8.4 ..	0.058 ..	0.115 ..	0.173 ..	0.230 ..	0.288 ..	0.346 ..	0.403 ..	0.461 ..	0.518 ..	0.576 ..
8.6 ..	0.056 ..	0.112 ..	0.169 ..	0.225 ..	0.281 ..	0.337 ..	0.393 ..	0.450 ..	0.506 ..	0.562 ..
8.8 ..	0.055 ..	0.110 ..	0.165 ..	0.220 ..	0.274 ..	0.329 ..	0.384 ..	0.439 ..	0.494 ..	0.549 ..
9.0 ..	0.054 ..	0.107 ..	0.161 ..	0.214 ..	0.268 ..	0.322 ..	0.375 ..	0.429 ..	0.482 ..	0.536 ..
9.2 ..	0.052 ..	0.105 ..	0.157 ..	0.210 ..	0.262 ..	0.314 ..	0.367 ..	0.419 ..	0.472 ..	0.524 ..
9.4 ..	0.051 ..	0.103 ..	0.154 ..	0.205 ..	0.256 ..	0.308 ..	0.359 ..	0.410 ..	0.462 ..	0.513 ..
9.6 ..	0.050 ..	0.100 ..	0.151 ..	0.201 ..	0.251 ..	0.301 ..	0.351 ..	0.402 ..	0.452 ..	0.502 ..
9.8 ..	0.049 ..	0.098 ..	0.147 ..	0.196 ..	0.245 ..	0.295 ..	0.344 ..	0.393 ..	0.442 ..	0.491 ..
10.0 ..	0.048 ..	0.096 ..	0.144 ..	0.192 ..	0.240 ..	0.289 ..	0.337 ..	0.385 ..	0.433 ..	0.481 ..
10.2 ..	0.047 ..	0.094 ..	0.141 ..	0.188 ..	0.235 ..	0.283 ..	0.330 ..	0.377 ..	0.424 ..	0.471 ..
10.4 ..	0.046 ..	0.092 ..	0.138 ..	0.184 ..	0.231 ..	0.277 ..	0.323 ..	0.369 ..	0.415 ..	0.461 ..
10.6 ..	0.045 ..	0.090 ..	0.136 ..	0.181 ..	0.226 ..	0.271 ..	0.316 ..	0.362 ..	0.407 ..	0.452 ..
10.8 ..	0.044 ..	0.089 ..	0.133 ..	0.178 ..	0.222 ..	0.266 ..	0.311 ..	0.355 ..	0.400 ..	0.444 ..
11.0 ..	0.044 ..	0.087 ..	0.131 ..	0.174 ..	0.218 ..	0.261 ..	0.305 ..	0.348 ..	0.392 ..	0.435 ..
11.2 ..	0.043 ..	0.085 ..	0.128 ..	0.171 ..	0.214 ..	0.256 ..	0.299 ..	0.342 ..	0.384 ..	0.427 ..
11.4 ..	0.042 ..	0.084 ..	0.126 ..	0.168 ..	0.210 ..	0.251 ..	0.293 ..	0.335 ..	0.377 ..	0.419 ..
11.6 ..	0.041 ..	0.082 ..	0.124 ..	0.165 ..	0.206 ..	0.247 ..	0.288 ..	0.330 ..	0.371 ..	0.412 ..
11.8 ..	0.040 ..	0.081 ..	0.121 ..	0.162 ..	0.202 ..	0.242 ..	0.283 ..	0.323 ..	0.364 ..	0.404 ..
12.0 ..	0.040 ..	0.079 ..	0.119 ..	0.159 ..	0.199 ..	0.238 ..	0.278 ..	0.318 ..	0.357 ..	0.397 ..
12.2 ..	0.039 ..	0.078 ..	0.117 ..	0.156 ..	0.195 ..	0.235 ..	0.274 ..	0.313 ..	0.352 ..	0.391 ..
12.4 ..	0.038 ..	0.077 ..	0.115 ..	0.154 ..	0.192 ..	0.230 ..	0.269 ..	0.307 ..	0.346 ..	0.384 ..
12.6 ..	0.038 ..	0.076 ..	0.113 ..	0.151 ..	0.189 ..	0.227 ..	0.265 ..	0.302 ..	0.340 ..	0.378 ..
12.8 ..	0.037 ..	0.074 ..	0.111 ..	0.148 ..	0.186 ..	0.223 ..	0.260 ..	0.297 ..	0.334 ..	0.371 ..
13.0 ..	0.037 ..	0.073 ..	0.110 ..	0.146 ..	0.183 ..	0.219 ..	0.256 ..	0.292 ..	0.329 ..	0.365 ..
13.2 ..	0.036 ..	0.072 ..	0.108 ..	0.144 ..	0.180 ..	0.216 ..	0.252 ..	0.288 ..	0.324 ..	0.360 ..
13.4 ..	0.035 ..	0.071 ..	0.106 ..	0.142 ..	0.177 ..	0.212 ..	0.248 ..	0.283 ..	0.319 ..	0.354 ..
13.6 ..	0.035 ..	0.070 ..	0.104 ..	0.139 ..	0.174 ..	0.209 ..	0.244 ..	0.278 ..	0.313 ..	0.348 ..
13.8 ..	0.034 ..	0.069 ..	0.103 ..	0.137 ..	0.172 ..	0.206 ..	0.240 ..	0.274 ..	0.309 ..	0.343 ..
14.0 ..	0.034 ..	0.068 ..	0.101 ..	0.135 ..	0.169 ..	0.203 ..	0.237 ..	0.270 ..	0.304 ..	0.338 ..
14.2 ..	0.033 ..	0.067 ..	0.100 ..	0.133 ..	0.166 ..	0.200 ..	0.233 ..	0.266 ..	0.300 ..	0.333 ..
14.4 ..	0.033 ..	0.066 ..	0.098 ..	0.131 ..	0.164 ..	0.197 ..	0.230 ..	0.262 ..	0.295 ..	0.328 ..
14.6 ..	0.032 ..	0.065 ..	0.097 ..	0.129 ..	0.162 ..	0.194 ..	0.226 ..	0.258 ..	0.291 ..	0.323 ..
14.8 ..	0.032 ..	0.064 ..	0.096 ..	0.128 ..	0.159 ..	0.191 ..	0.223 ..	0.255 ..	0.287 ..	0.319 ..
15.0 ..	0.031 ..	0.063 ..	0.094 ..	0.126 ..	0.157 ..	0.188 ..	0.220 ..	0.251 ..	0.283 ..	0.314 ..
15.2 ..	0.031 ..	0.062 ..	0.093 ..	0.124 ..	0.155 ..	0.186 ..	0.217 ..	0.248 ..	0.279 ..	0.310 ..
15.4 ..	0.031 ..	0.061 ..	0.092 ..	0.122 ..	0.153 ..	0.183 ..	0.214 ..	0.244 ..	0.275 ..	0.305 ..
15.6 ..	0.030 ..	0.060 ..	0.090 ..	0.120 ..	0.151 ..	0.181 ..	0.211 ..	0.241 ..	0.271 ..	0.301 ..
15.8 ..	0.030 ..	0.059 ..	0.089 ..	0.119 ..	0.149 ..	0.178 ..	0.208 ..	0.238 ..	0.267 ..	0.297 ..
16.0 ..	0.029 ..	0.059 ..	0.088 ..	0.117 ..	0.147 ..	0.176 ..	0.205 ..	0.234 ..	0.264 ..	0.293 ..
16.2 ..	0.029 ..	0.058 ..	0.087 ..	0.116 ..	0.145 ..	0.173 ..	0.202 ..	0.231 ..	0.260 ..	0.289 ..
16.4 ..	0.029 ..	0.057 ..	0.086 ..	0.114 ..	0.143 ..	0.172 ..	0.200 ..	0.229 ..	0.257 ..	0.286 ..
16.6 ..	0.028 ..	0.056 ..	0.085 ..	0.113 ..	0.141 ..	0.169 ..	0.197 ..	0.226 ..	0.254 ..	0.282 ..
16.8 ..	0.028 ..	0.056 ..	0.083 ..	0.111 ..	0.139 ..	0.167 ..	0.195 ..	0.222 ..	0.250 ..	0.278 ..
17.0 ..	0.027 ..	0.055 ..	0.082 ..	0.110 ..	0.137 ..	0.165 ..	0.192 ..	0.220 ..	0.247 ..	0.275 ..
17.2 ..	0.027 ..	0.054 ..	0.081 ..	0.108 ..	0.136 ..	0.163 ..	0.190 ..	0.217 ..	0.244 ..	0.271 ..
17.4 ..	0.027 ..	0.054 ..	0.080 ..	0.107 ..	0.134 ..	0.161 ..	0.188 ..	0.214 ..	0.241 ..	0.268 ..
17.6 ..	0.026 ..	0.053 ..	0.079 ..	0.106 ..	0.132 ..	0.159 ..	0.185 ..	0.212 ..	0.238 ..	0.265 ..
17.8 ..	0.026 ..	0.052 ..	0.079 ..	0.105 ..	0.131 ..	0.157 ..	0.183 ..	0.210 ..	0.236 ..	0.262 ..
18.0 ..	0.026 ..	0.052 ..	0.078 ..	0.104 ..	0.129 ..	0.155 ..	0.181 ..	0.207 ..	0.233 ..	0.259 ..
18.2 ..	0.026 ..	0.051 ..	0.077 ..	0.102 ..	0.128 ..	0.153 ..	0.179 ..	0.204 ..	0.230 ..	0.255 ..
18.4 ..	0.025 ..	0.050 ..	0.076 ..	0.101 ..	0.126 ..	0.151 ..	0.176 ..	0.202 ..	0.227 ..	0.252 ..
18.6 ..	0.025 ..	0.050 ..	0.075 ..	0.100 ..	0.125 ..	0.150 ..	0.175 ..	0.200 ..	0.225 ..	0.250 ..
18.8 ..	0.025 ..	0.049 ..	0.074 ..	0.099 ..	0.123 ..	0.148 ..	0.173 ..	0.198 ..	0.222 ..	0.247 ..
19.0 ..	0.024 ..	0.049 ..	0.073 ..	0.098 ..	0.122 ..	0.146 ..	0.171 ..	0.195 ..	0.220 ..	0.244 ..
19.2 ..	0.024 ..	0.048 ..	0.072 ..	0.096 ..	0.121 ..	0.145 ..	0.169 ..	0.193 ..	0.217 ..	0.241 ..
19.4 ..	0.024 ..	0.048 ..	0.072 ..	0.096 ..	0.119 ..	0.143 ..	0.167 ..	0.191 ..	0.215 ..	0.239 ..
19.6 ..	0.024 ..	0.047 ..	0.071 ..	0.094 ..	0.118 ..	0.142 ..	0.165 ..	0.189 ..	0.212 ..	0.236 ..
19.8 ..	0.023 ..	0.047 ..	0.070 ..	0.093 ..	0.117 ..	0.140 ..	0.163 ..	0.186 ..	0.210 ..	0.233 ..
	1	2	3	4	5	6	7	8	9	10

Determination of Lime Salts in Juices by Means of Soap Solution.

TABLE II.

SYRUPS AND MOLASSES.

Number of c.c. of Soap Solution.

Brix	1	2	3	4	5	6	7	8	9	10
20.0	0.046	0.092	0.138	0.185	0.231	0.277	0.323	0.369	0.415	0.462
20.1	0.046	0.092	0.138	0.184	0.230	0.275	0.321	0.367	0.413	0.459
20.2	0.046	0.091	0.137	0.183	0.228	0.274	0.320	0.366	0.411	0.457
20.3	0.045	0.091	0.136	0.182	0.227	0.272	0.318	0.363	0.409	0.454
20.4	0.045	0.090	0.136	0.181	0.226	0.271	0.316	0.362	0.407	0.452
20.5	0.045	0.090	0.135	0.180	0.225	0.269	0.314	0.359	0.404	0.449
20.6	0.045	0.089	0.134	0.179	0.223	0.268	0.313	0.358	0.402	0.447
20.7	0.044	0.089	0.133	0.178	0.222	0.267	0.311	0.356	0.400	0.445
20.8	0.044	0.088	0.133	0.177	0.221	0.265	0.309	0.354	0.398	0.442
20.9	0.044	0.088	0.132	0.176	0.220	0.264	0.308	0.352	0.396	0.440
21.0	0.044	0.088	0.131	0.175	0.219	0.263	0.307	0.350	0.394	0.438
21.1	0.044	0.087	0.131	0.174	0.218	0.262	0.305	0.349	0.392	0.436
21.2	0.043	0.087	0.130	0.173	0.217	0.260	0.303	0.346	0.390	0.433
21.3	0.043	0.086	0.129	0.172	0.216	0.259	0.302	0.345	0.388	0.431
21.4	0.043	0.086	0.129	0.172	0.214	0.257	0.300	0.343	0.386	0.429
21.5	0.043	0.085	0.128	0.171	0.213	0.256	0.299	0.342	0.384	0.427
21.6	0.042	0.085	0.127	0.170	0.212	0.255	0.297	0.340	0.382	0.425
21.7	0.042	0.084	0.127	0.169	0.211	0.253	0.295	0.338	0.380	0.422
21.8	0.042	0.084	0.126	0.168	0.210	0.252	0.294	0.336	0.378	0.420
21.9	0.042	0.084	0.125	0.167	0.209	0.251	0.293	0.334	0.376	0.418
22.0	0.042	0.083	0.125	0.166	0.208	0.250	0.291	0.333	0.374	0.416
22.1	0.041	0.083	0.124	0.166	0.207	0.248	0.290	0.331	0.373	0.418
22.2	0.041	0.082	0.124	0.165	0.206	0.247	0.288	0.330	0.371	0.412
22.3	0.041	0.082	0.123	0.164	0.205	0.246	0.287	0.328	0.369	0.410
22.4	0.041	0.082	0.122	0.163	0.204	0.245	0.286	0.326	0.367	0.408
22.5	0.041	0.081	0.122	0.162	0.203	0.244	0.284	0.325	0.365	0.406
22.6	0.040	0.081	0.121	0.162	0.202	0.242	0.283	0.323	0.364	0.404
22.7	0.040	0.080	0.121	0.161	0.201	0.241	0.281	0.322	0.362	0.402
22.8	0.040	0.080	0.120	0.160	0.200	0.240	0.280	0.320	0.360	0.400
22.9	0.040	0.080	0.119	0.159	0.199	0.239	0.279	0.318	0.358	0.398
23.0	0.040	0.079	0.119	0.158	0.198	0.238	0.277	0.317	0.356	0.396
23.1	0.039	0.079	0.118	0.158	0.197	0.237	0.276	0.316	0.355	0.395
23.2	0.039	0.078	0.118	0.157	0.196	0.236	0.275	0.314	0.354	0.393
23.3	0.039	0.078	0.117	0.156	0.195	0.235	0.274	0.313	0.352	0.391
23.4	0.039	0.078	0.117	0.156	0.194	0.233	0.272	0.311	0.350	0.389
23.5	0.039	0.077	0.116	0.155	0.194	0.232	0.271	0.310	0.348	0.387
23.6	0.039	0.077	0.116	0.154	0.193	0.231	0.270	0.308	0.347	0.385
23.7	0.038	0.077	0.115	0.154	0.192	0.230	0.269	0.307	0.346	0.384
23.8	0.038	0.076	0.115	0.153	0.191	0.229	0.267	0.306	0.344	0.382
23.9	0.038	0.076	0.114	0.152	0.190	0.228	0.266	0.304	0.342	0.380
24.0	0.038	0.076	0.113	0.151	0.189	0.227	0.265	0.302	0.340	0.378
24.1	0.038	0.075	0.113	0.151	0.188	0.226	0.264	0.302	0.339	0.377
24.2	0.037	0.075	0.112	0.150	0.187	0.225	0.262	0.300	0.337	0.375
24.3	0.037	0.075	0.112	0.149	0.187	0.224	0.261	0.298	0.336	0.373
24.4	0.037	0.074	0.111	0.148	0.186	0.223	0.260	0.297	0.334	0.371
24.5	0.037	0.074	0.111	0.148	0.185	0.222	0.259	0.296	0.333	0.370
24.6	0.037	0.074	0.110	0.147	0.184	0.221	0.258	0.294	0.331	0.368
24.7	0.037	0.073	0.110	0.146	0.183	0.220	0.256	0.293	0.329	0.366
24.8	0.036	0.073	0.109	0.146	0.182	0.219	0.255	0.292	0.328	0.365
24.9	0.036	0.073	0.109	0.145	0.182	0.218	0.254	0.290	0.327	0.363
25.0	0.036	0.072	0.109	0.145	0.181	0.217	0.253	0.290	0.326	0.362
25.1	0.036	0.072	0.108	0.144	0.180	0.216	0.252	0.288	0.324	0.360
25.2	0.036	0.072	0.107	0.143	0.179	0.215	0.251	0.286	0.322	0.358
25.3	0.036	0.071	0.107	0.143	0.178	0.214	0.250	0.286	0.321	0.357
25.4	0.036	0.071	0.107	0.142	0.178	0.213	0.249	0.284	0.320	0.355
25.5	0.035	0.071	0.106	0.142	0.177	0.212	0.248	0.283	0.319	0.354
25.6	0.035	0.070	0.106	0.141	0.176	0.211	0.246	0.282	0.317	0.352
25.7	0.035	0.070	0.105	0.140	0.175	0.211	0.246	0.281	0.316	0.351
25.8	0.035	0.070	0.105	0.140	0.175	0.209	0.244	0.279	0.314	0.349
25.9	0.035	0.070	0.104	0.139	0.174	0.209	0.244	0.278	0.313	0.348
	1	2	3	4	5	6	7	8	9	10

will give CaO to 100° Brix :—

$$\text{CaO to 100° Brix} = \frac{\text{c.c. soap solution}}{2 \times \text{Brix} \times \text{sp. gr.}}$$

Using only 10 c.c. of thick-juices, syrups, and molasses :—

$$\text{CaO to 100° Brix} = \frac{\text{c.c. soap solution}}{\text{Brix} \times \text{sp. gr.}}$$

Check tests must be run on the water frequently and changes made in amount of soap necessary to produce foam, when required.

Table I is for use of thin-juices. Take 20 c.c. and make up to 50 c.c. with distilled water.

Table II is for use of syrups and molasses. Use 10 c.c. and make up to 50 c.c. with distilled water.

A mark placed above the zero on the burette will be found convenient, and eliminates the trouble of deducting 0.5 c.c. of soap solution from each test.

Example of use of Table : — 20 c.c. thin-juice of 12.2° Brix required 1.4 c.c. soap. From the table on the line opposite 12.2 in the Brix column, 0.039 + (0.156 × 0.1) = 0.039 + 0.0156 = 0.0546, which is the CaO per 100° Brix.

American Commerce Reports.¹

NEW SUGAR INDUSTRY IN HONDURAS.

Honduras is to be the scene of a big sugar boom in the very near future according to a report by Vice-Consul GERBERICH of the Puerto Cortes district of that Republic. Three companies are to make the new industry possible, one of which is to grow the sugar cane, a second to make the sugar, and the third will largely take care of its transportation to the American market. A complete sugar mill with initial capacity of crushing 1500 tons of cane in 24 hours is to be installed by a company incorporated under the laws of Honduras with a capital of \$2,000,000. Moreover, the mill is so designed that by comparatively small additions to the present machinery it will have an ultimate capacity of 6000 tons per day. The contract calls for its completion and delivery by April 1st, 1921. This mill is to be located in the village of La Lima, ten miles east of San Pedro Sula, on the right bank of the Chamelecon River and in the heart of the new sugar region. This whole section between the Chamelecon and the Ulua is a level alluvial stretch of land admirably adapted to the growing of sugar cane. The corporation formed to grow cane for the new enterprise, which is owned in part by the same interests as the mill projectors, controls 30,000 acres of land here, two-thirds of which is available for sugar cane. At present a railway is being built toward La Lima from Omonita, which will secure connexion with Puerto Cortes. Work on another line is expected to be begun directly, which will enter La Lima from the south and join the main line of the National Railway at a point above Chamelecon. It is stated that an entirely new village is to be built at La Lima, with residences, storehouses, offices, a hotel, waterworks, sewerage system, and an electric lighting system.

SUGAR PRODUCTION AND CONSUMPTION IN PARAGUAY.

The sugar production of Paraguay is confined to the manufacture of raw cane sugar. There are eight small factories, with a total daily capacity for cane sugar of 670 tons.

These plants are supplied from cane growth locally, the estimates of the total area planted ranging from 5000 to 7000 hectares. The average gross production of sugar cane per hectare is about 11 metric tons. The planting months are May to August, and the cutting months are June to October. The sugar yield does not exceed 5 per cent.

¹ Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

American Commerce Reports.

More than two-thirds of all the sugar refined in the country is the output of one plant, the Asucarera Paraguaya at Tebicuary. During 1919 the amount of sugar, alcohol, and caña (rum) produced by the refineries was : sugar, 2490 metric tons ; alcohol, 377,315 litres ; rum, 46,350 litres.

According to official returns, Paraguay's sugar imports during 1913-1919, in kilos, were :—

	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Refined sugar	2,545,639..	1,816,186..	33,680..	1,287,543..	1,200,351..	33,187..	96,178
Unrefined sugar..	15,400..	4,515..	820..	201,630..	941,434..	2,267,221	2,466,782
Grand total..	2,561,039.	1,820,701.	34,600..	1,439,173.	2,141,785.	2,300,408..	2,562,960

Prior to the war it came chiefly from Germany and Austria.

The official statistics show the exports of sugar to be small and the destinations confined to neighbouring Republics.

Droughts and occasional frosts interfere somewhat with the cultivation of sugar cane in Paraguay. If, however, improved agricultural implements were introduced to take the place of the primitive ones now in use, if roads were opened up over which to haul the cane to the refineries, and if better machinery were installed in the refineries, the sugar yield of this country could be increased manifold. As the annual consumption of sugar in Paraguay averages about 3,000,000 kilos, it may be expected that the production of raw sugar will soon be brought up to this amount. But until better methods of cultivating the land are adopted, more roads built, and a more dependable class of labour found than the average Paraguayan, it is hardly possible to expect any great advancement in the sugar industry.—[Consular Report, June, 1920.]

THE SUGAR INDUSTRY IN BRAZIL.

In 1917 Brazil had registered 215 sugar factories, classified as follows :—105 factories grinding less than 100 tons of cane in 12 hours ; 77 grinding from 101 to 200 tons ; 17 grinding from 201 to 400 tons ; 3 grinding over 401 tons ; 13 for which no details of production were given.

The cane is all crushed in the country. In many places in the interior rudimentary appliances, made of hardwood, are still used to crush the cane. These establishments, producing dark-brown cake sugar ("rapadura"), consumed by the labourers on the farm, do not figure in any statistics, and the total production cannot be estimated. It is large, however. Small American crushers with three vertical steel cylinders are often used on farms and in small factories, driven by human or animal power. Some factories have up-to-date machinery ; only one factory so far, however, has introduced the diffusion process in Brazil—the Uzina Esther, in São Paulo, with a daily capacity of 125 tons of cane.

Most of the production is used for consumption in Brazil ; only the surplus is exported. Exports in the years 1914 to 1919, inclusive, were in the following quantities (one metric ton = 2204·6 lbs.) :—

Kinds.	1914. Metric tons.	1915. Metric tons.	1916. Metric tons.	1917. Metric tons.	1918. Metric tons.	1919 Metric tons.
White sugar	1,365 ..	2,833 ..	31,201 ..	98,179 ..	94,720 ..	(a)
Yellow crystals..	20,876 ..	22,064 ..	12,974 ..	10,541 ..	8,984 ..	(a)
Brown sugar....	9,619 ..	34,178 ..	9,650 ..	22,789 ..	11,930 ..	(a)
Total.....	31,860 ..	59,075 ..	53,825 ..	131,509 ..	115,634 ..	69,429

a Classification not yet available.

THE SUGAR INDUSTRY IN PERNAMBUCO. •

Pernambuco's most important crop is sugar, in the production of which it leads all the other districts of Brazil ; due to the fertility of its soil and the suitability of its climate, it assumed preeminence in the sugar industry shortly after the first European settlements, and it was from this district that the first known exportation of sugar was made from Brazil to Portugal, in 1526.

The following table shows the annual sugar production of Pernambuco for the years 1913 to 1919, inclusive, as well as the exports of that staple to foreign countries, expressed in metric tons, and the proportion of exports to production :

YEAR.	SUGAR PRODUCTION. Metric Tons.	SUGAR EXPORTED. Metric Tons.	EXPORTS TO PRODUCTION. Percentage.
1913-14	142,000	7,505	5.3
1914-15	155,000	56,772	36.6
1915-16	101,000	13,960	13.8
1916-17	171,000	89,728	52.5
1917-18	170,000	60,189	35.4
1918-19	186,000	61,273	33.0

The following figures show the average prices of sugar per 15 kilos (33 lbs.) during the years 1913-19 (converted at the rate of 4 milreis to the dollar): 1913, \$1.30; 1914, \$1.01; 1915, \$1.15; 1916, \$1.93; 1917, \$2.25; 1918, \$2.26; and 1919, \$2.50.

The sugar crop of 1920-21 is expected to exceed that of any of the years mentioned. The rainfall has been abundant, and the sugar men are of the opinion that the yield will be about 4,000,000 bags (240,000 metric tons).

The export of sugar during 1919 was, and is still, subject to Government control. In order to obtain an export licence, the exporter is required to ship to Rio de Janeiro either on consignment or sold, an amount equal to 50 per cent. of the amount exported, subject to the requisition of the Federal Government. This restriction has resulted in a material curtailment of exports. The principal foreign customers were Uruguay, Argentina, United States, Great Britain, France, Italy, and Spain. However, it seems that two of these customers may be lost to Brazil—Argentina, which took over 50 per cent. of Pernambuco's 1918-19 total export of sugar, has ceased to import that commodity, as its present production is not only sufficient for itself, but enables it to supply the needs of Uruguay, another important market in the past for Pernambuco's sugar.

The present somewhat uncertain condition of the sugar industry in Pernambuco may be said to be due to lack of modern equipment for the mills, as well as agricultural machinery for the better development of production. Sugar mill equipment and administration are not in an advanced state. The machinery in use is nearly all of old design. There is also a general lack of steam pressure. The result is that only an average of 7 per cent. of sugar is extracted from cane which is said to contain from 12 to 14 per cent.

The sugar machinery in use throughout the district at the present time is almost all of either British or French manufacture. As these sources of supply were cut off by the war there have been few new installations for the past six years. It is rarely that one meets with or hears of any American sugar machinery in Pernambuco. The causes for this are said to be that American manufacturers usually require full payment in advance of shipment, while the usual payment terms of American competitors were one-third against documents at point of shipment, one-third upon arrival in Brazil, and one-third after the machinery had been erected. It is also said that, taking advantage of the closing of the European market during the war, some American firms supplied the local market with machinery of poor quality.

The sugar industry is the chief basis of Pernambuco's wealth. The political and commercial leaders of the district are alive to the fact that the present lack of the most modern industrial equipment in the industry is causing a loss of about \$9,000,000 annually. It is believed that the near future will witness a substitution on a large scale of the present antiquated types of mill and agricultural equipment by the most modern and efficient machinery and equipment.—[Consular Report, August, 1920.]

FINLAND.

At the beginning of 1919 there was no raw sugar in Finland and none was on its way there. The Sugar Committee had been unable to get any in 1918, although it had endeavoured to procure some from the Ukraine, and the importation from over-sea countries had not yet been organized. A shipment of 1400 tons of brown Cuba raw sugar was received from London in February and distributed among the four sugar refineries in the country, Tolo, Aura, Wasa, and Kotka.

Other shipments arrived later, and the total imports of sugar during 1919 amounted to approximately 33,800 metric tons. No sugar is being offered by the United States now,

American Commerce Reports.

owing to the shortage of the Cuban crop, and the Finnish Sugar Co. states that it is compelled to buy exclusively white Java No. 25 and small lots of Czecho-Slovakian white crystals.

Of the quantities received in 1919 about 3800 tons were distributed directly as granulated and refined, 21,200 tons were refined in Finnish factories, and 8800 tons remained in the factories. The refining of the dark brown raw sugar was very difficult at first, as the factories in Finland are equipped for the refining of only high-grade raw sugar.

All the purchases of raw and granulated sugar have been made on account of the Food Ministry. The sugar has been refined at a fixed sum per ton and the proceeds from the sales transferred to the Food Ministry.

There were formerly six different sugar refineries in Finland, but on January 1st, 1919, they were combined into one limited company, Finska Socker Aktie-Bolaget (Finnish Sugar Co.), with a paid-up capital of 50,000,000 marks. Only the four largest refineries have been working. They have a total capacity of more than 60,000 tons annually.

There is only one raw sugar factory in Finland, the Suomen Raakasokeritehdas Osakeyhtiö (Finnish Raw Sugar Factory), which has a capital of 7,500,000 marks. It is located in Salo and turns out from 300 to 400 tons of white beet in 24 hours.

The spring of 1919 was the first time that any beets were grown in Finland for the manufacture of sugar. The cultivated area was about 590 hectares and the crop 4989 tons. The poor harvest was due partly to the lack of fertilizers and scarcity of workmen, and partly to the fact that the farmers did not understand the cultivation of the beet. The best crop per hectare was 39 metric tons.¹ The above-mentioned factory did not begin work until the end of February, 1920, and is consequently not yet able to give the average percentage of sugar obtained. It states that the cultivated area is already 1035 hectares, and that the farmers are beginning to take more interest in the cultivation of the sugar beet.—[Consular Report, July, 1920].

THE SUGAR INDUSTRY IN BULGARIA.

The sugar industry of Bulgaria is limited to the production of beet sugar. Experiments are now being made with a view to testing the adaptability of Bulgarian soil to the growing of sugar cane, and prospects appear to be favourable.

The number of acres planted in beet, the total production of sugar beet, the total production of refined sugar, and the imports of sugar into Bulgaria from 1910 through 1920 are shown in the following table:—

YEAR	AREA IN BEETS. Acres.	SUGAR BEETS. Metric tons.	REFINED SUGAR. Metric tons.	IMPORTS OF SUGAR. Metric tons.
1913	10,564 ..	67,600 ..	7,352 ..	23,155
1914	37,495 ..	182,821 ..	21,861 ..	9,829
1915	21,494 ..	98,696 ..	11,591 ..	2,036
1916	28,849 ..	104,303 ..	9,022 ..	1,711
1917	31,435 ..	93,248 ..	10,472 ..	1,673
1918	39,581 ..	44,845 ..	3,396 ..	—
1919	21,414 ..	129,677 ..	11,861 ..	4,953
1920	23,255 ..	(a) ..	(a) ..	(b) 2,500

(a) Figures not completed. (b) Until August 1st.

The factories all possess refineries, although those at Philippopolis and Kayali are not yet completed. The refineries in Sofia, Rustchuk, and Gorna Orchovitza each have a refining capacity of 120 to 150 metric tons of raw sugar per 24 hours.

The greater part of the sugar imported into Bulgaria has come from Austria or Germany. Of that imported in 1919, 4823 tons was imported from Czecho-Slovakia. No sugar is exported from Bulgaria, since domestic production does not equal the consumption. Statistics are not kept showing the stocks of sugar on hand at the beginning of each crop or fiscal year.

¹ Say 15½ metric tons per acre.

The estimated population of Bulgaria within its new boundaries as established by the treaty of Neuilly is slightly over 4,000,000.

Prior to the world war the price of refined sugar varied from 60 centimes (\$0.116) to 1 franc (\$0.193) per kilo. During the war the price per kilo was as follows:—1915, 1.35 leva (1 leva = \$0.193 at normal rate of exchange); 1916, 2.20 leva; 1917, 2.70 leva; and 1918, 10.85 leva. During the last two years the price has varied from 15 to 18 leva. At the present time sugar is retailed at 25 leva per kilo in Sofia.¹—[Consular Report, November, 1920.]

Correspondence.

THE WEST INDIES AND INDUSTRIAL ALCOHOL.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—In the prospective use of alcohol as a motor agent instead of petrol and for general purposes where power is required, the West Indies have attracted considerable attention on account of their being sugar-producing colonies, in which molasses would be available for its production. The amount of the latter which, in those colonies, could be devoted to the production of motor spirit, is rather difficult to estimate, inasmuch as the manufacture of rum and molascuit, especially the former, causes the consumption of a considerable quantity. Thus, taking the annual home consumption of rum (the United Kingdom is practically the only market for it) at 3,000,000 proof gallons, a quantity rather beyond the present consumption, 5,000,000 gallons of modern factory molasses is required. The output in sugar of British Guiana and the West India Islands may be looked upon in the near future as being 300,000 tons, from which, reckoning still on modern factory work, 13,500,000 gals. of molasses would be obtained. There would thus be available for purposes other than rum 8,000,000 gallons. From these, however, have to be deducted the quantities of the higher quality sold for consumption, the amount earmarked for molascuit, and for the purposes of the estate; 7,500,000 gallons may therefore be considered as the quantity which could be devoted to motor spirit, and these may be calculated as capable of yielding 3,000,000 gallons of 95 per cent. alcohol.

As the position now stands in the West Indies, there is no doubt that Trinidad, Barbados, St. Kitts, and Antigua could profitably convert their surplus molasses into motor spirit, and not only be self-supporting in this respect but also supply the neighbouring islands. Thus, Trinidad could supply Tobago, Grenada, and St. Vincent; Barbados could make up the deficiency in St. Lucia; while Antigua could supply the small wants of Montserrat. In Jamaica, the sugar industry is extending, and the surplus molasses will soon be sufficient to supply the island power wants. In British Guiana it is difficult to say what will happen, but a considerable proportion of the power wanted in that colony could be produced by alcohol from the surplus molasses.

As regards the description of de-naturing, no doubt in Trinidad it would be done by admixture with petrol. In the other parts of the West Indies Natalite could be made by conversion of a portion of the spirit with sulphuric ether.

It must not be forgotten that there is in British Guiana a considerable quantity of rice straw available from the growing rice industry. This could yield by hydrolysis with sulphuric acid a fermentable sugar from which alcohol could be made in conjunction with that from molasses.

This use of alcohol for motor purposes would make the West Indies and British Guiana self-supporting as regards the requirements of internal combustion engines, and it would also be quite possible to utilize it for lighting and heating purposes as a substitute for kerosene oil.

I am, Sir, yours, etc.,

F. I. SOARD.

¹ Say \$2.19 or 9s. 2d. per lb. at pre-war rates—ED., I.S.J.

Publications Received.

Rübensirup, seine Herstellung, Beurteilung, und Verwendung. (Beet Syrup, its Production, Valuation, and Use.) By Berthold Block. (Verlag von Otto Spamer, in Leipzig, Germany.) 1920. Price: M 24.

During the war the production of a table syrup by the evaporation of beet juice increased to a marked extent, reaching during the season 1918-19 a quantity of about 33,000 tons. Mr. BERTHOLD BLOCK considers that this industry has now become of sufficient importance to justify the publication of this book describing its manufacture. Briefly the stages consist of washing, peeling, scalding, comminuting and pressing the roots, the juice thus obtained being strained, heated, filtered and evaporated to a syrup of about 80° Brix. A few of the more important points mentioned in the sections dealing with these matters may here be noted. Generally the juice is submitted to little or no clarifying treatment as in beet sugar manufacture, and lime is not even added as a rule, though attention is directed to the possibilities of decolorizing carbons (e.g., "Carboraffin") for the removal of impurities and the elimination of colour. Filtration of the untreated juice through cloth is difficult on account of its colloidal nature; but this is overcome by heating to effect coagulation and by adding suitable "aids," Kieselguhr to the amount of 0.5 to 2 per cent. being found the most efficient. An important matter is the prevention of the crystallization of the finished syrup, and this may be done, as investigations by A. HERZFELD¹ and H. EGGBRECHT² have shown,

by so arranging that the ratio $\frac{\text{sucrose}}{\text{invert sugar}}$ shall be as nearly 1 : 1 as possible.

H. CLAASSEN³ has proposed the addition of 70 grms. of sulphuric per 100 kg. of roots before commencing the evaporation, and others have tried the effect of hydrochloric, phosphoric and various vegetable acids (as tartaric and citric); but very satisfactory results are stated to be obtained by adding 0.1 per cent. of formic acid to the expressed juice, this small amount producing under ordinary conditions the required inversion. As to yields, it is said that in a good factory about 20 kg. of syrup (at 80° Brix) are obtainable from 100 of roots. Fuel consumption figures state that per 100 kg. of syrup 56-59 kg. of coal are required in good working for both scalding and evaporation. Average analyses of *Rübensirup* show the following values: water, 18.78; sucrose, 37.74; invert sugar, 42.22; ash, 2.73; and acidity 1.16 per cent. (dry substances), the rotation of a 10 per cent. solution in a 200 mm. tube being + 3.47, and the ratio $\frac{S}{I}$ being 0.9 : 1.0.

Regarding its colour and taste, samples which have been received by the reviewer show the former to be dark-brown, and the latter to be very sweet with a slight "beety" flavour and faint bitter after-taste, the pleasant aroma possessed by cane syrups of course being lacking. On the whole, this beet product judging from the samples examined can hardly be compared with the "table syrup" of average quality on the English market at the present day.

Practical Plant Biochemistry. Muriel Wheldale Onslow. (University Press, Cambridge). 1920. Price: 15s. net.

It is explained in the preface by Mrs. WHELDALE ONSLOW that her book is intended to serve as a practical laboratory manual, experiments being described which are devised to enable the student to extract from the plant itself the chemical compounds of which it is constituted, and to learn something of their properties. Doubtless the book will prove serviceable for this purpose; but, in addition to the experimental data, it presents a really excellent general survey of the subject of plant chemistry, which should be appreciated quite widely. It gives a very clear account of carbon assimilation, and of the synthesis of the first-formed carbohydrate (probably a hexose), which later is condensed to form more complex disaccharides (e.g., sucrose) and polysaccharides (as starch, cellulose, etc.). Other chapters are devoted to the building-up of proteins, fats, and aromatic compounds;

¹ *Festschrift z. Eröffn.*, Berlin, 1904, p. 670.

² *Centr. Zuckerind.*, 1908, 523.

³ *Centr. Zuckerind.*, 1910, 946.

and to the rôle played by enzymes in the processes concerned, namely, hydrolysis, oxidation, and synthesis. A large amount of information has been compressed into the pages of this book, on the whole in an interesting form. There is unfortunately a very noticeable error on page 48 in stating the structural formula of α and β glucose. This, we hope, will be corrected in an early second edition of Mrs. Onslow's useful small book, which we recommend confidently to all those desiring to acquire the general principles of plant chemistry.

The Yeasts. By Alexandre Guilliermond D.Sc.; translated and thoroughly revised by F. W. Tanner, M.S., Ph.D. (Chapman and Hall, Ltd., London; John Wiley and Son, Inc., New York.) 452 pages; 163 figures. 1920. Price: 33s. net.

Prof. GUILLIERMOND, a well-known French investigator, published in 1912 "Les Levures," a book which was very favourably received by all interested in the study of micro-organisms. It collected in one volume a large amount of knowledge on the morphology, physiology, and taxonomy of the yeasts, arranging the information in such a form as to be readily accessible for biologists, practitioners in industrial work, agriculturists and others concerned with the subject. Prof. TANNER (of the University of Illinois, U.S.) has now undertaken the translation of the book in order to make it more available to students in America and in this country; but while doing this the opportunity has been taken in collaboration with Prof. GUILLIERMOND to add much new matter. These authors divide their book into two parts: Part I contains nine chapters, dealing successively with morphology and development of the yeasts; cytology; physiology, nutrition, respiration and alcoholic fermentation; parasitism; origin of the yeasts; methods of culture and isolation; characterization and identification; variation of species; and classification. Part II contains four chapters which are devoted to a descriptive study of the various species, particulars being given of all the yeasts that are known at the present time, though of course owing to their great number a close examination of each can hardly be expected in a volume of this size. The book forms a useful compendium of general information on the yeasts hitherto published elsewhere in other treatises and in different periodicals, and it is a work of reference that will be found of much value by all engaged in the fermentation industries.

Emil Fischer Memorial Lecture. Delivered October 28th, 1920, by M. O. Forster, F.R.S. (Chemical Society, Burlington House, Piccadilly, London, W.). Price: 1s. 6d. (paper covers).

Variedades de Cana (Cane Varieties). F. S. Earle. Circular No. 23 (Insular Experiment Station, Rio Riedras, Porto Rico). 1920.

Carbon Dioxide of the Soil Air. H. W. Turpin. Memoir 32 (1920), Cornell University, Agricultural Experiment Station, Ithaca, New York, U.S.A.

Lime: Its Properties and Uses. Circular No. 30. (Bureau of Standards, Washington, D.C., U.S.A.). 1920. Price: 5 cents.

Die Herstellung von Spiritus aus Melasse und Guanol aus Melasse-Schlempe. Ludwig Wilkening. (Druck von Wilh. Riemschneider, Hannover.) 1919.

Die Arbeitsweise der Zuckerraffinerien. Dr. Felix Langen. (Schallehn & Wollbrück, Magdeburg.) 1919. Price: M. 60.

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INCRUSTATION PREVENTION IN SULPHITATION FACTORIES BY COUPLING-UP JUICE HEATERS.
G. Benthem. Archief voor de Suikerindustrie in Nederlandsch-Indië, 1920, 28, No. 27, 1040-1042.

Referring to the article on this subject published by Mr. VOLLENHOVEN,² the author states that from observations made in the Sentanenlor factory, Java, he is able to confirm the satisfactory results obtained in respect of scale diminution by uncoupling the juice-heaters devoted to the limed and sulphited juice and using them for the heating of the raw untreated juice. However, since a thin layer of scale is always much easier to dissolve than a thick one, he prefers to switch over from the heating of one kind of juice to another more frequently, say after only six hours, instead of the 3-5 days mentioned in the previous article. In this way, the surface of the tubes is kept free from any considerable thickness of scale, and a better transmission of heat is secured throughout. It would appear that the reason of the removal of the scale being so complete when changing over from the heating of one juice to another, although only 50 per cent. is soluble, is due to the fact that soluble and insoluble portions are intimately mixed, so that when the soluble portion goes into solution, the rest is left as a soft mass to be carried away by the current of liquid. A scale scraped from the tube of a heater which had been used for limed and sulphited juice gave the following figures:—Water, 9.87; organic matter, 16.20; insoluble in hydrochloric acid, 5.75; phosphoric acid (as P_2O_5), 0.88; iron and alumina, 0.54; magnesia, 0.37, lime (CaO), 34.51; sulphuric acid (SO_3), 2.90; sulphurous acid (SO_2), 28.84; carbon dioxide and undetermined matter, 0.13; and a trace of copper.

PRESENCE OF OXALIC ACID IN THE SUGAR CANE *J. E. Quintus Bosz. Archief voor de Suikerindustrie in Nederlandsch-Indië, 1920, 28, 969-974.*

WINTER³ was not able to establish the presence of oxalic acid in the sugar cane (nor that of citric acid), though he applied several different methods of identification; and KOHL⁴ also concluded that all the *Gramineæ* are likewise free from this constituent. GREERLIGS,⁵ however, stated that it is to be detected in cane with other organic acids, but he did not mention the source of his information. KOBUS⁶ found 11.27 per cent. of calcium oxalate in the scale from the third and fourth vessels of a quadruple in a factory in Java, but it is of course possible that the oxalic acid might not have originated from the cane, but might have been formed as the result of the action of micro-organisms in the sand-catchers, measuring tanks, and such places where there is opportunity for fermentation to occur. Most of it would be precipitated by the lime in clarification, but as calcium oxalate is slightly soluble in solutions containing sugar (depending upon the concentration), some would pass on to the evaporators. In order, however, to settle this interesting point, about 15 kg. of 100° POJ cane (after eight months' growth) was crushed in a laboratory mill, and the juice evaporated to a syrup, a hydrochloric acid extract of the bagasse being similarly treated. Both liquids were examined by the method prescribed by BRUNHLOT and ANDRÉ,⁷ consisting in boiling, filtering off any insoluble matter, rendering slightly alkaline with ammonia, adding boric acid and ammonium chloride, making strongly acid with acetic, and stirring in an excess of calcium acetate, the mixture being then heated for at least an hour not quite to boiling point. After filtering hot, the precipitate of calcium oxalate (which is not quite pure) is re-dissolved in hydrochloric acid, and re-precipitated with ammonia, this being done twice. It is lastly dried at 100° (its water of crystallization is liberated only at 200°C.), ashed, and again weighed, the

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, I.S.J.)

² I.S.J., 1920, 586.

³ *Mededeelingen v. h. Proefstation voor Suikerriet in West-Java, Kagok-Tegal, deel I, p. 37.*

⁴ "Kalksalze u. Kieselsäure in der Pflanze," Marburg, 1888, p. 57.

⁵ "Cane Sugar and its Manufacture," page 51.

⁶ *Archief*, 1900, 2, 693.

⁷ *Comptes rendus*, 1885, 101, 354. ⁸ Rümpler's "Die Nichtzuckerstoffe der Rüben," 1885, p. 68.

calcium oxide obtained being calculated to oxalic acid. Operating in this way, Dr. Boss found 0.01366 per cent. (on the cane) of oxalic acid $(\text{COOH})_2 + 2\text{H}_2\text{O}$, and micro-chemical examination showed the precipitate obtained on adding the calcium acetate to consist of calcium oxalate. Confirmatory tests that were applied with positive results were the explosive property of the silver salt,¹ and its determination by titration with thiocyanate after solution in nitric acid, 0.3979 grm. of silver oxalate being taken, and 0.4026 grm. being found. This result related to the juice expressed from the cane, and only 0.00045 per cent. of oxalic was found in the bagasse, showing that the oxalic acid in the cane occurs in water-soluble combination.

USE OF KIESSELGUHR FOR THE REMOVAL OF THE COLLOIDAL MATTER OF CANE JUICES.

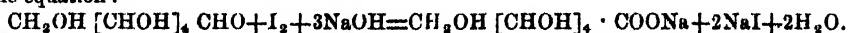
H. S. Paine and C. F. Walton, Jr. Paper read before the Sugar Section of the American Chemical Society, at Chicago, September, 1920.

In attempting to ascertain the relative values of various samples of kieselguhr for filtering cane juice, it was found that the determination of the purity of the juice before and after the filtration was unsuitable, as but little difference in this datum resulted. Better results were obtained by measuring the amount of colloidal matter removed by the kieselguhr. A cane syrup was diluted to 16° Brix; 200 c.c. of this "juice" were heated with varying amounts of kieselguhr; the liquid was thoroughly dialysed through a colloidal membrane; and the residual matter dried and weighed. It was thus found that 10-15 per cent. of the colloidal matter originally present was removed by the kieselguhr alone, while "Norit" decolorizing carbon removed nearly all. On the other hand, Fuller's earth removed very little. A porous rather than a dense variety of kieselguhr should be used.

DETERMINATION OF REDUCING SUGARS BY OXIDATION WITH IODINE. Hilda M. Judd.

Biochemical Journal, 1920, 14, No. 2, 255-262.

BOUGAULT,² COLIN and LIEVIN,³ and others⁴ have attempted to determine reducing sugars by assuming that while the aldose (dextrose) is oxidized by iodine in alkaline solution, the ketose (levulose) under certain conditions is inappreciably affected. WILLSTÄTTER and SCHUDDEL⁵ have pointed out that the course of the reaction depends upon the amount and concentration of the alkali present, of which there must be a sufficiency to neutralize all the acid formed, but not an excess, otherwise the reaction is not complete. According to them, the oxidation proceeds best with N/10 solutions in the proportions required by the equation:—



If these conditions are fulfilled (they state) the error with glucose is not more than 1 per cent., and neither levulose nor sucrose is attacked. Miss JUDD found it impossible to confirm this conclusion; and experiments made with pure sugars showed that while the oxidation of the dextrose is never complete, there is always a partial action on the levulose. Attempts to find conditions ensuring the complete oxidation of the dextrose without the levulose being attacked were unsuccessful. It is suggested that the chief source of error is the action of dilute alkalis on sugars in bringing the transformation investigated by LOBBY DE BRUYN and VAN EKENSTEIN,⁶ which appears even in the presence of such a weak alkali as lead hydroxide, the dextrose being converted into levulose and mannose, and the levulose yielding a proportion of dextrose and mannose.

However, it was found that a given weight of dextrose always uses up a definite and constant weight of iodine (though not the theoretical amount), these weights being independent of changes in the alkali content, or of the presence of other sugars. This statement is true also of levulose. It is, therefore, possible by following either the method of COLIN and LIEVIN, or that of WILLSTÄTTER and SCHUDDEL, to calculate the amount of each sugar present in a solution by combining the cupric reducing power with

¹ Beilstein's "Organische Chemie," third edition, Vol. I, p. 646.

² *J. Pharm. Chim.*, 1917, 16, 97.

³ *Bull. Soc. Chim.*, 1918, 47, 403.

⁴ *J.S.J.*, 1919, 411.

⁵ *Berichte*, 1918, 51, 780.

⁶ *Rec. Trav. Chim.*, 1895, 14, 156, 208.

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its iodine absorbing power. This procedure was found very convenient in the case of fruit juices, for which the customary method combining the specific rotatory power with the ouptic reducing power was unsatisfactory on account of the low optical activity of the samples examined. This particularly applies to apple juice, in which the sugars are sucrose, dextrose, and levulose, the excess of the latter causing the liquid to have a very small polarimetric reading.

INDUSTRIAL ALCOHOL. *Burnell R. Tunison. Journal of the Franklin Institute, 1920, 190, No. 3, 375-420.*

A general review of the subject is given by the author (of the U.S. Industrial Alcohol Co.), in which reference is given to other literature on the subject.¹ It is mentioned that the U.S. Geological Survey finds that the petroleum reserves above ground are being rapidly depleted. "As the price of gasoline increases, and as its quality becomes poorer . . . alcohol will attain an ever-increasing importance in this field." A mixture of alcohol, gasoline (petrol) and other components² has been developed which possesses (it is stated) remarkable properties, being much more efficient as a fuel compared with gasoline under identical conditions. Flying machines used in the U.S. Post Office Airplane Mail Service are being operated with an alcohol fuel; and tests show a great increase in the number of miles per gallon, an increase in power, and a very marked saving in the quantity of lubricating oil used, in support of which statement figures are given.³

FORMATION OF LEVAN BY MOULD SPORES. *N. Kopeloff, L. Kopeloff, and C. J. Welcome. Journal of Biological Chemistry, 1920, 43, 171-187.*

Spores of the mould *Aspergillus sydowii* form levan in sucrose media, and the disaccharide is hydrolysed before utilization, the levulose being used to a greater extent than the dextrose in the formation of the gum. It would appear necessary that the sugars be present in what the authors term the "nascent state" for the synthesis of levan to be possible, as it was found that little formation occurs in media containing reducing sugars from ordinary sources. An enzyme, levanase, affects this synthesis, and its action is influenced by the reaction of the medium. Levan yields levulose on hydrolysis. Its specific rotation is -40 .

SOME CHARACTERISTICS OF SUGARS IMPORTED INTO THE U.S.; PRESENCE OF ACARUS AND WORMS IN RAWS; AND THE DETERIORATION OF PLANTATION WHITES. *C. A. Browne. Paper read before the Sugar Section of the American Chemical Society, September, 1920.*

During recent years the tendency has been toward the production of a 96° sugar, and since 1916 the amount of this grade imported into the U.S. has been in the neighbourhood of 75 per cent. of the total received. The average polarization of sugars for each month of the year follows a regular curve, being highest in April when it averages 96°, and lowest in October when it falls to 94.5°. This decrease of 1.5 is due largely to the deterioration of the raw sugar in the warm summer during storage or transit. If these raw sugars were cured properly, the loss from deterioration could be prevented, and the percentage of sugar testing 96° could be increased to 80 or 83 per cent.

Various tropical climates produce raw sugars of such definite characteristics that chemical analysis, physical appearance, or biological examination, will in many cases establish their origin. Thus, the sugar from British Guiana has its reducing sugars in an optically-inactive form⁴; while certain localities impart peculiarities to the composition of the ash. *Acarus sacchari* (the sugar mite), although reported of general occurrence in muscovados, seems to be largely absent from modern centrifugal sugars; but shipments of raw sugar have been condemned owing to the presence of worms (larvae of *Piophilis casei*

¹ Crampton, "Production and Use of Denatured Alcohol" (Department of Commerce Publication; special agents' series, No. 77). DACHEMIN, *Bull. Soc. d'Encour. Ind. Nationale*, vol. 126.

² For abstracts of various patents by the U.S. Industrial Alcohol Co., see *I.S.J.*, 1919, 528; 1920, 236, 477, 582.

³ *Journal of the Society of Automotive Engineers*, 5, No. 3, 207.

⁴ *I.S.J.*, 1919, 823.

and *Dermestes vulpinus*), which had crawled into the sugar for pupation from bales of hides that were stored nearby. These larvae do not feed upon sugar.

During past years of scarcity, a considerable quantity of unrefined plantation white sugar has been imported into the U.S. for direct consumption. Some of this consisted of ordinary centrifugal sugar that had been washed to remove the film of adhering molasses, being bagged in an undried condition. Such sugars deteriorate very rapidly; but washed sugars when dried, either by steam or in mechanical dryers, keep well. The lower grades have a polarization of about 99.0°, and are of a dingy grey colour; but if suitable care be used in manufacture, plantation white sugar can be made of brilliant whiteness polarizing 99.8-99.9°.

CHEMICAL CONTROL RESULTS OBTAINED IN A QUEENSLAND MILL. J. F. Foster.
Annual Reports of the Mulgrave Central Mill Co., Ltd., 1920.

During the 1919 season, 79,023 tons of cane were crushed, and the rate of grinding was 25 tons per hour, the extraction being 93.43 per cent. with 33.37 per cent. maceration. Altogether 10,284 tons of 94° net titre sugar were made, equal to 7.68 tons of cane per ton of sugar; while other values were: "Commercial cane sugar" in the cane, 14.19 per cent.; purity first roller juice, 87.74°; purity of the mixed juice, 85.59°; maceration, 33.37 per cent.; mixed juice per ton of cane, 220 gall.; purity of the final molasses, 47.43°; wood burnt, 308 tons; wood per ton of 94 n.t. sugar, 0.03 ton; n.t. of sugar, including "jolly," 97.89; coefficient of work, 91.71 per cent. Regarding the sucrose balance, the total loss was 20.20 per cent., this being distributed as follows: in the bagasse, 6.57; press-cake, 0.53 per cent.; molasses, 8.49; and undetermined, 4.61 per cent. About 93 per cent. of the cane delivered was Badilla; 3 per cent. D1135; 2 per cent. Goru; 1.4 per cent. Malagashe; and 0.6 per cent. HQ426. The evaporation per sq. ft. of heating surface was 0.50, and the liquor was delivered to the pans at high sp. gr. The sugar was of good quality, and well dried (containing 0.15 per cent. of moisture), suffering only a very slight deterioration when stored.

THE POEM OF THE PHILOSOPHER THEOPHRASTOS UPON THE SACRED ART (ALCHEMY).

C. A. Browne. *The Scientific Monthly*, 1920 (September), 193-214

Among the remains of Greek literature that have come down from the Byzantine period are four poems in iambic verse upon the divine or sacred art. These poems, in the fifteen or more manuscripts, which are preserved in different libraries of Europe, form part of a large collection of works upon alchemy. Most of the prose manuscripts of this collection were edited and translated by the French chemist, BERTHELOT, in 1888. The four poems, although a part of BERTHELOT's original plan, were not included in his edition of the Greek alchemists, and, except for a meagre summary of their contents by REINESIUS in 1634 and a few brief extracts by HOEFER in his "Histoire de la Chimie" in 1866, no efforts have been made to give a rendering of their contents in any modern language. Dr. BROWNE in this article gives the result of his study of these poems. He has made a metrical translation of the Greek manuscript, extracts from which are here reproduced. He further presents a commentary, explanatory of the history and theory of ancient alchemy, an addition which should prove a valuable contribution to this very interesting subject.

IRRIGATION IN CUBA. *Cuba Review*, 1920, 18, 13-17. *Journal des Fabricants de Sucre*, 1920, No. 26.

In this article attention is drawn to the fact that, although irrigation has been practised for a considerable time in Cuba and found profitable among sugar planters, the methods adopted are often very primitive, the colonos simply flooding the whole land. There would appear to be very few places where irrigation is economically possible in Cuba. In some it is of little advantage because of the excessive cost of the works, while in others the amount of water available is insufficient for the needs of the cane fields. In the south of

¹ *I.S.J.*, 1919, 121; 1920, 284.

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Matanzas and Santa Clara provinces, however, near the estates of Constancia and Socorro, artesian wells have been sunk which, at the depth of a little over 100 ft., have reached good supplies of water. The pressure is sufficient to throw a column of water 13-17 ft. above the level of the ground. This is distributed by a powerful pump, and Constancia alone receives daily from 13 to 17 million gallons during the period when irrigation is necessary. In commenting on the above a writer in the *Journal des Fabricants de Sucre* thinks that irrigation is bound to spread, although progress may be slow; it will come into more general use when the threatened fall in the price of sugar arrives, and when it will be necessary to adopt more intensive agriculture so as to obtain more sugar per acre than is done at present. He points to the northern coast lands of the Santa Clara province as especially suitable because of the great quantity of underground water; and also to the northern part of the Oriente province, where large rivers on the high land could easily be diverted so as to irrigate great stretches of sugar cane land.

CONSTITUENTS OF CANE WAX. J. E. Quintus Bosz. *Archief voor de Suikerindustrie in Nederlandsch-Indië*, 1920, 28, No. 25, 974-977.

In 1914 the writer received a kerosine tin of cane wax from the Sentanenlor factory, Java, where a plant for its extraction had been installed, and on examination found it had a m. p. of 60-62° C., an acid value of 47.3, a saponification value of 177, and a nitrogen content (as N) of 0.01 per cent. At the outset of his investigation into the nature of the wax, he applied the usual colour reactions for cholesterol, but was unable to obtain any positive indication of its presence. After saponifying, adding hydrochloric acid, and shaking out with benzene, a layer of fatty acids resulted, which was washed with warm water, and converted according to FARNSTEINER¹ into lead salts. On cooling the benzene solution, a crystalline precipitate was obtained, which was re-crystallized from benzene. The lead salts were decomposed in warm water with hydrochloric acid, and the layer of fatty acids washed with hot water. The product gave an m. p. of 54.0° C. and its iodine value was 0. It appears that WIJNBERG² had also isolated an acid having an m. p. of 54° C. Dr. Bosz at first believed the fatty acid substance to be myristic acid, which has an m. p. of 53.8° C., but later from its molecular weight of 270 obtained by titration came to the conclusion that it was a mixture of palmitic and stearic acids, forming a "eutectic" compound, which, so far as its m. p. is concerned, behaves as a single pure chemical substance.³ Another portion of the saponified product was steam-distilled, and this by tests which need not here be detailed was identified as myricyl alcohol,⁴ which body was obtained by STURKE from carnuba wax. In another portion of the distillate caproic acid⁵ was found, and this liquid also smelt strongly of formic acid, the presence of which was established by its reducing action towards salts of silver and mercury and alkaline permanganate.⁶ Tests were applied for the presence of acetic, benzoic, and cinnamic acids, but unsuccessfully.

EXAMINATION (CHEMICAL AND MICROSCOPICAL) OF BAGASSE FROM THE POINT OF VIEW OF PAPER MAKING. F. Heim, J. Maheu, and L. Matrod. *La Papeterie*, 1920, 42, 539-542; 578-587.

A chemical and microscopical examination of bagasse received from Guadeloupe has been made by the writers at the Laboratoire général des Productions coloniales, and their conclusions are to the effect that the pulp which can be produced from it may be regarded as a raw material of average quality for the paper manufacturer.

J. P. O.

¹ *Zeitsch. f. Unters. d. Nähr. und. Genussm.*, 1898, 390.

² "Het rietwas" (Amsterdam), 1909, page 94.

³ This phenomenon is frequently encountered in the analysis of oils, fats, and waxes. Mixtures of fatty acids are known (palmitic and stearic is one of the best known) which cannot be resolved into their components by crystallization from alcohol, and several fatty acids, formerly regarded as individuals, have been found to be eutectic compounds.—ED. F.S.J.

⁴ A wax is an ether of a monohydric alcohol, the chief constituent of beeswax, e.g., being myricyl palmitate.

⁵ *Liebigs Annalen*, 223, p. 263. ⁶ Rosenthaler's "Nachweis organischer Verbindungen," p. 288.

Review of Recent Patents.¹

GERMANY.

PRODUCTION AND REVIVIFICATION OF A CARBON OF GREAT DECOLORIZING POWER.

(1) *Österreichischer Verein für Chemische und Metallurgische Production.* 290,656. April 25th, 1914. (2) *Farbenfabrik vorm. Bayer & Co.*, of Leverkusen b. Köln a. Rh., Germany. 307,761. June 19th, 1917.

(1) Wood, starch, carbon (including spent carbon), animal waste product, etc., are mixed with an equal (or multiple) weight of zinc chloride, either in the water-free condition or in the form of ordinary commercial 50° liquor, and heated in a suitable vessel to the temperature at which the zinc chloride commences to be volatilized. At this point the mass is cooled, treated with sufficient dilute acid to dissolve out the basic zinc salt, the mixture being filtered, washed, and dried. (2) This specification claims for the process of increasing the absorptive power of the carbon produced according to the previous patent by heating the carbon to a higher temperature (400°C. being mentioned).

ELECTRICALLY-HEATED DISTILLATION APPARATUS. *Allgemeine Elektrizitäts-Gesellschaft* in Berlin. 323,414. October 26th, 1918.

The liquid is heated by utilizing its resistance according to the electrode principle in a special heater with which is combined a storage tank through which a condenser worm passes, so that the condensation of the vapours from the heater serves to preheat a fresh quantity of liquid.

PURIFICATION OF SUGAR SOLUTIONS BY MEANS OF COLLOIDAL SILICIC ACID. *Otto Biemann*, of Magdeburg. 320,846. November 22nd, 1916.

Highly diluted sodium silicate solution is treated with carbon dioxide gas until the colloidal silicic acid has all separated out, after which the precipitate is washed repeatedly with an aqueous solution of carbon dioxide until permanently neutral (this requiring repeated tests owing to the fact that after a time when the wash-liquors are running neutral an alkaline reaction may again occur). This silicic acid is added to the suitably warmed liquid (starch glucose, for example) with which it is stirred. After subsiding, it is found that solid substances, and uncombined or incompletely combined organic salts, have been carried down. It is claimed that in this way solutions can be freed from salts, and their odour, colour, and taste also removed. Silicic acid obtained by treatment with hydrochloric acid retains sodium chloride, which therefore adds to the mineral matter contained in the liquid treated.

METHOD OF CLARIFYING JUICES, SYRUPS, ETC., BY TREATING WITH DECOLORIZING CARBON. *Johann N. A. Sauer*, of Amsterdam, Holland. 322,135. March 6th, 1919; June 17th, 1920.

When decolorizing carbon is used for the treatment of juices, syrups, and other liquors, it is rather quickly exhausted owing to its contamination with the more readily removable impurities, the frequency of revivification and consequently its cost thus being increased. This invention provides a preliminary treatment with a relatively small quantity of a cheap carbon made by dry-distilling bagasse or beet pulp in closed retorts, the addition of which to the juice removes a large amount of organic and inorganic substances, though little of the colouring matters. After use, the spent carbon may be mixed with the bagasse going to the furnaces. Regarding the decolorizing carbon afterwards added, it is said that this may be obtained from the carbon used for the preliminary treatment by heating it in absence of air with hot gases (as ammonia, carbon dioxide, carbon monoxide, chlorine, or superheated steam); or it may be produced directly from bagasse or beet pulp by heating in absence of air, while conducting the gases mentioned through

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

at the same time. In an example of the procedure recommended, it is stated that the mill juice after measuring or weighing is heated with 0.1—5.0 per cent. (by weight) of the preliminary treatment carbon in mixers, after which the liquid is pumped through filter-presses. Alternatively, juice clarified by the common defecation method, by liming and sulphitation, or by the carbonatation process, is submitted to the action of the carbon for the preliminary treatment. In either case, the carbon is filtered off, and the clear juice mixed with the decolorizing carbon, following which it is filtered, evaporated to a syrup, and boiled to grain. Or again, the juice may first be subjected to the effect of kieselguhr, fuller's earth, etc., before adding successively the preliminary treatment carbon and the decolorizing carbon.

DRY DISTILLATION OF CARBONATATION SCUMS FOR THE PRODUCTION OF TERPENES AND OTHER PRODUCTS. *H. Stoltzenberg*, of Berlin-Wilmersdorf, Germany. 316,503. August 8th, 1917.

On dry-distilling the scums (which are dried immediately produced), the oily and aqueous fractions are worked up separately to resin substitutes, pyridine basis, acetone, and Pirrole Red. Alternatively the scums may be separated into three fractions by precipitation, obtaining (1) a resinous fraction yielding a high percentage of terpenes and resin; (2) a fraction with a high nitrogen content yielding mainly pyridine bases; and (3) a fraction rich in fatty acids, yielding principally acetone.

HOLLAND.

REGENERATION OF ANIMAL CHARCOAL WHICH IN CONJUNCTION WITH PHOSPHORIC ACID IS USED AS A CLARIFYING AGENT FOR SUGAR PRODUCTS. *Kwanto Sanso Kabushiki-Kaisha, Ltd., Takakazu Hayashi, and Emejiro Emura*, all of Tokyo, Japan. 4417. September 21st, 1919; January 2nd, 1920.

A preparation for clarifying sugar products is made by acting on animal charcoal (or phosphorite) with sulphuric acid, filtering, precipitating the excess of sulphuric acid by heating for 1-2 hours at 60-80°C. with a calcium or aluminium compound, distilling off most of the water *in vacuo*, and mixing the phosphoric acid thus obtained with about 50 per cent. of animal charcoal to give a product having the consistency of a paste. This patent relates to the regeneration of the char preparation thus obtained. When the impurities that it has taken up in use are small, that is, after it has been used only once, regeneration is effected simply by washing with a solution of phosphoric acid (or suitable phosphate) at 2-5 Bé., followed by water. When the impurities are greater, the char is either heated with a sodium hydroxide solution at 5-10° Bé., or is re-burnt, after which in both cases it is washed first with phosphoric acid, and then with water. It is said that the best results are obtained by applying a supplementary washing with sulphurous acid (or sulphites); either before washing with the phosphoric acid, or else before the final washing with water and drying. Char regenerated in any of these ways is mixed with the purified phosphoric acid to a paste, and used again.

CLARIFICATION OF RAW CANE JUICES FOR PLANTATION WHITE SUGAR MANUFACTURE, USING A DECOLORIZING CARBON MADE FROM FILTER-PRESS CAKE. *Henri Otto de Ruyter de Wildt*, of Djokjakarta, Java. 4877. April 1st, 1920.

Raw mill juice without being submitted to any previous chemical treatment (being only screened to separate the fine bagasse and sand, etc.) is boiled, either with a special carbon prepared from filter-press cake, or else with "any other known clarifying agent" (sufficient being added to produce a water-white liquid), and the whole subsequently filtered. It is said that the special carbon is made by heating the ordinary filter-press cake obtained from a neighbouring muscovado factory to about 450°C. in the absence of air, extracting the residue with dilute hydrochloric acid, and finally filtering and washing it with condenser water. Its revivification may be effected by heating the carbon after it has adsorbed the impurities of the juice to 380-400°C. in the absence of air, this operation being repeated

after each time of use. Reference is made by the inventor in his specification to the article by HAZZWINKEL,¹ in which the use of a carbon made from press-cake was also described; but it is said the new preparation is unsuitable for the purpose HAZZWINKEL had in view, namely, to treat juices or syrups already clarified in some way or other. The carbon claimed in the present specification differs both in composition and in manner of use.

UNITED KINGDOM.

PRODUCTION OF SACCHARIC AND TARTARIC ACIDS FROM CARBOHYDRATES (STARCH, ETC.).

Diamalt-Aktien-Gesellschaft, of Munich, Germany. 108,494 (11,302).

August 4th, 1917; convention date, August 4th, 1916; September 9th, 1920.

EMIL FISCHER was the first to obtain tartaric acid from saccharic acid by oxidation, the saccharic acid in turn being obtained from starch or other carbohydrate. Claim is now made for a process of obtaining saccharic and tartaric acids from carbohydrates by oxidation by means of sulphuric and nitric acids, or sulphuric acid and nitrogen oxides peroxidized by treatment with oxygen, ozone, or air, at a temperature of 100° C., characterized by the employment of catalysts consisting of members of the heavy metal group, more especially molybdenum and mercury, and also by precious metals, as platinum. Mixtures of these metals, their oxides or salts, also give (it is said) excellent results.

LIME KILNS. *C. Candlot*, of Paris, France. 150,994 (22,595). July 29th, 1920; convention date, September 10th, 1919; not yet accepted; abridged as open to inspection under Section 91 of the Act.

Apparatus for discharging lime kilns is described, as the result of which the bottom is given a composite rotary motion, resulting in an even removal of the material. In a modification, the bottom may be perforated for partial discharge, or may be reduced in diameter and surrounded by a fixed conical ring.

SACCHARIFICATION OF CELLULOSE. *Zellstofffabrik Waldhof and V. Hottenroth*, of Waldhof, Mannheim, Germany. 147,415 (19,314). July 7th, 1912; convention date, April 18th, 1917; not yet accepted; abridged as open to inspection under Section 91 of the Act.

Wood or other cellulose-containing material is mixed with sulphuric acid of about 75 per cent. strength to form a paste which is allowed to stand for some time and then mixed with water and boiled for saccharification. The acid may be separated by addition of lime either before or after filtering to separate the lignin bodies. Dextrin-like products are obtained by treating the paste, after standing, with cold water, separating the acid by addition of lime and filtration, and evaporating the solution. Sodium bisulphate may be used in place of sulphuric acid.

PREPARATION OF YEAST, USING MOLASSES AND PEAT. *A. Vasseux*, of St. Mandé, Seine, France. 147,581 (19,515). July 8th, 1920; convention date, January 19th, 1918; not yet accepted; abridged as open to inspection under Section 91 of the Act.

In preparing bakers' yeast, peat is mixed with cane or beet molasses, or with juices of beet, apples, pears, or artichokes, either in the cold or while heated. An acid wort is filtered from the mixture and is fermented during aeration. Sulphuric or other acid and nutrient substances such as phosphates, blood, malt culms, and ammonium salts may be added. The residual peat may be used as manure. Worts are also obtained by heating the residual peat or untreated peat with acids or bases.

CONFECTIONERY MANUFACTURE. *Ballochmyle Creamery Co. and R. McCrone*, of Auchinleck, Ayrshire, N.B. 150,588 (31,341). December 18th, 1919.

In boiling sugar to make toffee, a mixture of margarine and a "sugar inverter," such as citric acid, is added.

¹ *I.S.J.*, 1911, 274.

Patents.

COATING CONFECTIONERY. *National Equipment Co., of Springfield, Mass, U.S.A.* 150,799 (14,321). June 6th, 1919.

In a machine for coating confectionery, the excess of material is returned to the supply tank from which it was drawn, and means are provided for acting on the material in the tank to free it from air bubbles before it is again used. A preliminary bottom coating is given before the complete coating is applied.

CLEANING BEETS. *Wellen Mfg. Co., of Chicago, U.S.A.* 150,828 (14,773). June 11th, 1919.

A load of beets is dumped into a hopper, and admitted to a conveyor, which delivers it to an inclined rotary where it is cleaned. The cleaned roots fall into a hopper, and are subsequently weighed; while the refuse goes into a separate receptacle.

MOTOR BEET HARVESTER. *O. Frankman, of Malmo, Sweden.* 150,911 (25,799). October 21st, 1919.

Each of the broad driving-wheels of beet harvesting machines is replaced by two or more narrower wheels, all the wheels being connected to one another and to the driving-motor in such a way that the wheels at one side of a machine can rotate independently of those at the other side; and the wheels on the same side can either rotate independently of one another, or can be disconnected from one another while the machine is turned.

BEET HARVESTER. *Morse Hammervaerk and R. Neilsen, of Nykobing, Mors, Denmark.* 150,345 (24,586). August 24th, 1920; convention date, November 1st, 1917; not yet accepted; abridged as open to inspection under Section 91 of the Act.

A machine is described for harvesting beet, the more salient features of which comprise means for raising and lowering both the front and the rear part of the frame, for mounting the top cutters so that they may swing laterally, and for preventing lateral movement of the machine on sloping ground.

DECOLORIZATION BY FILTRATION THROUGH ALUMINA. *I. J. Hood, of Ialington, London, N.* 149,453 (12,699). May 20th, 1919.

A granular aluminous material, for use in the decolorization of liquids¹ is prepared by moistening finely-divided aluminous material, such as precipitated alumina, bauxite dust, or China-clay, with an acid or an aluminium salt solution, heating to form an agglomeration, then either crushing this and calcining at a dull red heat or *vice versa*, and finally grading the product. The alumina content may be increased by adding pure alumina to the starting material. (Specifications 7032/05 and 16,617/08 are referred to.)

HARVESTING BEET MACHINE. *G. Saur, of Paris.* 149,462 (13,043). May 23rd, 1919. †

A machine for harvesting beet comprises a rotary top-cutter, digging shares, an inclined conveyor, and a receiving hopper, and is provided with a pivoted V-shaped draught-bar to facilitate operation by hauling cables connected to winding engines at the ends of the field.

DOUBLE CRUSHER FOR CANE MILLS.² *Fulton Iron Works Co., St. Louis, Miss., U.S.A., (assignees of L. E. Lortz).* 146,280 (17,136). June 24th, 1920; convention date, January 13th, 1917; not yet accepted; abridged as open to inspection under Section 91 of the Act.

STOVE FOR CONFECTIONERS. *James McG. and Thomas F. Murray, and John G. Steven, of Glasgow, Scotland.* 143,424 (17,292). July 10th, 1919; May 27th, 1920.

¹ See also *I.S.J.*, 1920, 178.

² See also U.S. Patent, 1,201,096; *I.S.J.*, 1919, 471.

UNITED STATES.

FERTILIZER FOR ACID SOILS CONTAINING DI-CALCIUM PHOSPHATE. *Carlton C. James*, of Honolulu, T.H. 1,348,495. May 28th, 1917; August 3rd, 1920. (Two figures.)

A fertilizer containing di-calcium phosphate not only tends to neutralize the acidity of the soil, but promotes bacterial activity, and adds available phosphoric acid to the soil. Claim is made for the preparation of such a material by mixing together 80 parts of acid phosphate containing 18-20 per cent. of P_2O_5 in the form of mono-calcium phosphate; 5 parts of calcium oxide containing 90-95 per cent. of CaO; and 15 parts of calcium carbonate in the form of ground coral sand. This mixture is immediately packed in bags, barrels, etc., which, open to the atmosphere, are allowed to stand overnight, during which time the chemical reaction is completed. The resulting product is a basic (or reverted) phosphate fertilizer in the state of a dry, floury powder, in which about 83.3 per cent. of the P_2O_5 is present as di-calcium phosphate, 5.6 as mono-calcium phosphate, and 11.1 as tri-calcium phosphate. It may be applied to the soil broadcast, or by drilling in the well-known manner.

FERTILIZER CONTAINING CALCIUM CYANIDE AND DICALCIUM PHOSPHATE. *John N. Carothers* (assignor to *Newton D. Baker*, U.S. Secretary for War, Trustee). 1,350,591. January 14th, 1920; August 24th, 1920.

Calcium phosphate is subjected to the action of a concentrated solution of nitric acid (containing more than 40 per cent. of HNO_3 by weight) to form mono-calcium phosphate and calcium nitrate. Sufficient calcium cyanide containing free lime to substantially convert the mono-calcium phosphate to di-calcium phosphate is then added.

FILTER¹. *John J. Berrigan* assignor to *Henry R. Worthington Corporation*, of New York, U.S.A. 1,350,492. December 2nd, 1915; August 24th, 1920.

PREPARATION OF ABSOLUTE ALCOHOL. *George B. Frankforter*, of Minneapolis, Minn., U.S.A. 1,350,354. December 20th, 1918; August 17th, 1920.

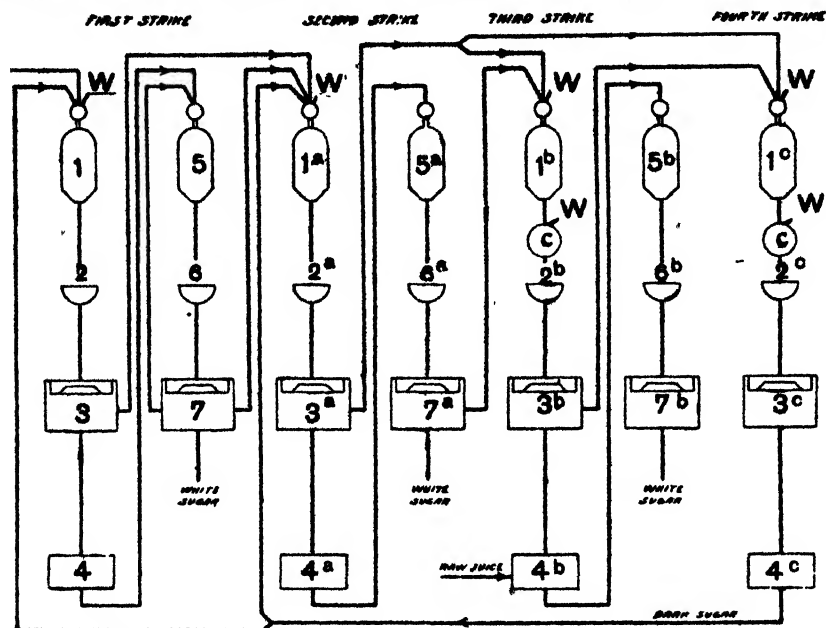
Common commercial alcohol is treated with a mixture of potassium carbonate and potassium fluoride so as to remove some of the water, decanted, and heated in an autoclave retort under a pressure of about 55 lbs. per sq. in., with quicklime until all but a trace of water remains. This trace is eliminated finally by distilling, and passing the vapour formed over calcium carbide.

PROCESS OF BOILING WHITE GRANULATED SUGAR. *Rudolph E. Pospisil and Edmund Kurek*, of Madison, Wisconsin, U.S.A. 1,352,084. December 27th, 1915; September 7th, 1920.

All the sugar is extracted as a pure high quality white granulated by this process, which is an improvement upon a previous specification.² It relates to a large extent to the purification of the massecuite by injecting water during the treatment in the pan and in the crystallizers, the four strikes being boiled as follows: *First strike*—Raw juice is boiled in pan 1, where it is treated with injections of water at the point marked *W* while its temperature is being raised so as to volatilize impurities as ammonia, ammonium carbonate, and ammonium acetate, and to decompose other nitrogenous compounds, thus raising the purity of the massecuite, which treatment is repeated many times until the massecuite is finished, when it is passed successively into the mixer 2, the centrifugal 3, and the melter 4. After treating and filtering the liquor resulting from remelting, it is again boiled in pan 5 to massecuite, dropped successively into mixer 6 and centrifugal 7, the crystals thus obtained being pure, white granulated of 99-99.5 per cent., the wash-water being returned to the pan 5, as shown clearly in the diagram. *Second strike*—Syrups from centrifugals 3 and 7 are boiled in pan 1a to grain, and submitted to the

¹ Cf. U.K. Patent, 140,798.² U.S. Patent, 1,028,272; *I.S.J.*, 1912, 480.

water-injection treatment, the procedure after this being clearly shown in the diagram, the sugar from separator 7^a being white granulated of the same quality as the first. *Third strike*—Similarly part of the syrup from centrifugals 3^a and all that from 7^a are boiled in pan 1^b, and after the water injection treatment the massecuite is dropped into crystallizers 5^b, where water injection is used again and is continued "as long as necessary to prevent the crystals from taking on the impurities." After this, treatment takes place successively in mixer 2^b, centrifugal 3^b and melter 4^b, in which the crystals are re-melted and mixed with high raw juice. This liquor is boiled to grain in pan 5^b, and on



going through mixer 6^b and separator 7^b a high quality granulated sugar is obtained. *Fourth strike*—The remainder of the syrup from centrifugal 3^a of the second strike and all the molasses of centrifugal 3^b of the third strike are boiled blank in pan 1^c, water injection being applied as before, and repeated in the crystallizers 5^c. After passing through mixer 2^c and separator 3^c, a dark sugar is obtained, which is re-melted in melter 4^c completing the strike. Part of this dark sugar is mixed with the raw juice in pan 1^a, while the other part goes to pan 1^a. Syrup from centrifugal 3^c is being constantly used to raise the purity of the molasses; that from 3^a and 3^b is boiled over many times until all the sugar is extracted.

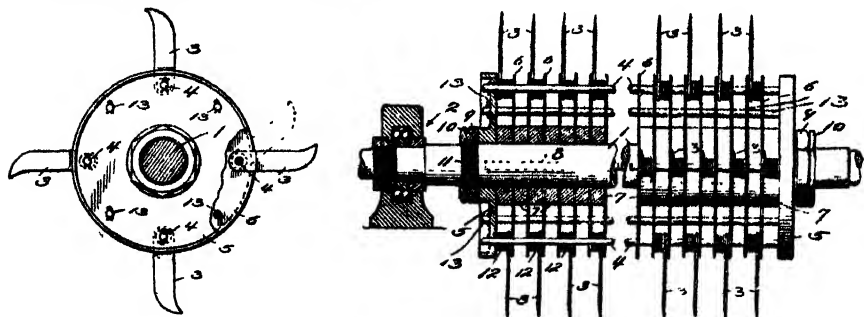
CANE CUTTER. *William Searby*, of Punene, T.H. 1,348,751 (serial, 186,380). August 15th, 1917; August 3rd, 1920. (Two figures.)

The specification relates to an improvement on the construction protected by RAMSAY¹ in apparatus for cutting the cane during its transit to the mills into small lengths, thereby reducing its bulkiness, and facilitating its feed.

It includes a central shaft 1 driven from the motor by suitable gearing, and mounted in suitable bearings (preferably that bearing the mark "S. K. F.") as shown at 2. It is provided with a number of knives 3, which are light, and thin, and are free to swing in the direction of their planes, i.e., at right angles to the major axis of shaft 1. They are loosely pivoted on rods 4, by which they are supported, these rods being parallel to and radially equi-distant from the shaft 1. Endplates 5 are included, constituting heads in

¹ U.S. Patent, 1,309,518, of December 19th, 1916.

which the ends of the rods 4 are suitably secured, as by openings through which the ends of the rods 4 provided with cotter pins project. The rods 4 are intermediately supported by a number of plates 6 held by spacing blocks 7, fitted on shaft 1. Heads 5, plates 6, and blocks 7 are keyed to the shaft 1, as at 8, and held by nuts 9, backed by lock-nuts 10, the shaft 1 being threaded for this purpose. The position of the knives 3 on the rods 4 is determined by spacing washers 12, fitted on the rods in the spaces between the plates 6, the end-plates, and the adjacent heads 5.



The knives 5 are resilient (preferably made of spring steel), and hence they may yield laterally in either direction from their normal planes in consequence of glancing blows upon the hard rind of the cane; and it is to be noted that the washers 12 are sufficiently loose to provide a certain measure of lateral play. The rotor is adapted for high speed developing centrifugal force, which causes the knives to strike the cane sufficiently intensely to cleave the hard rind. The pivotal mounting of the knives on the rods 4, whereby the knives are free to swing in the direction of their planes provides for deflection when an obstacle is encountered. This is advantageous; first, because the knives when in contact with the cane assume an angle, in opposition to centrifugal force wherein they produce a draw out; and second, because if an obstacle is encountered the knives will yield pivotally, and in the majority of cases their breakage will be avoided. Furthermore, the apparatus may be constructed at a low cost.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

MOTOR FUELS. *U.S. Industrial Alcohol Co.* (1) 153,925 (11,419). May 7th, 1919.

(2) 154,867 (23,995). May 7th, 1919. (3) 140,796 (8796). October 12th, 1917.

MANUFACTURE OF GLYCERIN FROM SUGAR. *Vereinigte Chemische Werk A. G.* 133,328 (1974). Addition to 133,099. April 22nd, 1916.

REGENERATING HYDROCHLORIC ACID USED IN GLUCOSE MANUFACTURE. *H. Terrisse and M. Levy.* 154,170 (12,751). November 15th, 1919.

REMOVAL OF SCALE FROM BOILERS, ETC. *J. P. Martinussen.* 154,342 (21,283). August 29th, 1919.

EVAPORATION OF LIQUIDS. *Aktiebolaget Industare.* 154,355 (21,674). September 3rd, 1919.

HEAT-INTERCHANGE DEVICES FOR EVAPORATORS. *E. Wirth-Frey.* 142,077 (1971). April 23rd, 1919.

CENTRIFUGAL MACHINE FOR FILTERING LIQUIDS. *J. McIntyre.* 154,641 (13,706). May 30th, 1919.

EVAPORATING PROCESS. *J. C. Stead.* 154,762 (25,169). October 14th, 1919.

APPARATUS FOR CLARIFYING LIQUIDS HAVING FINELY DIVIDED MATTER IN SUSPENSION. *W. M. MacKay.* 154,767 (25,721). October 21st, 1919.

FILTERS FOR STRAINING AND FILTERING LIQUIDS. (1) *C. Thomas.* 154,783 (27,924). November 11th, 1919. (2) *L. Penkala.* 154,612 (33,931). December 1st, 1919.

FILTER-PRESSES. *A. Ten Bosch.* 154,817 (1678). January 19th, 1920.

FILLING SUGAR MOULDS. *H. Delvenne.* 145,526 (16,910). September 20th, 1918.

PREVENTION OF CORROSION. *L. Renger and W. Fuhrmann.* 154,610 (33,838). April 12th, 1919.

Brevities.

A Cuban central which was erected not long since at a cost of £1,600,000 is reported to have been sold within a few months of its completion for the sum of £2,800,000

According to the *Times Trade Supplement*, it is calculated that at the close of 1920 London held possibly 70,000 tons of stored sugar, Liverpool 85,000 tons and Glasgow 50,000 tons.

A shortage of labour in Mauritius has resulted from the suspension of Indian immigration, and attempts are now being made to maintain the necessary workers in the canefields by obtaining men from the agricultural districts of South China.

F. VAN VOLLENHOVEN¹ recently described experiments in which he showed that cane juice may deteriorate to the extent of 0.23 per cent. sucrose (by polarization) in the cane between the time that it leaves the mill and reaches the measuring tanks, the necessity of rapid working and of frequent cleaning thus being demonstrated.

According to the *Cuba Review*, there is a shortage of labour in Cuba which has led to various centrals bringing into the island a considerable number of labourers from other countries. Thus the Trinidad Sugar Company has imported 250 negroes from Jamaica; the Báguanos Sugar Company a thousand Haitian labourers; while the Immigration Agent has been authorized to procure 200 Chinese coolies from Hong Kong.

Dr. W. R. ORMANDY in a recent lecture² said there was every reason why starch products would be grown in tropical countries for the production of alcohol for motor fuel and similar purposes. There is an area in British East Africa, the size of Kent, which, if planted with the right sort of crops (maize, bananas, etc.), would produce an amount of alcohol that would displace the petrol used throughout the British Isles. He advocated a system of co-operation between agriculturist and distiller.

A filter is described by GERHARD SCHMITT³ for the treatment of fine or colloidal suspensions, and is stated to be applicable in the sugar industry for the separation of "slimy substances." It consists of a perforated metal cylinder surrounded by numerous rings of fine wire gauze, which can be pressed together by a screw so that the size of the pores is regulated. A screw conveyor within the cylinder forces the liquid through the cylinder, the actual filtering medium being the deposit itself.

The kingdom of the Serbs, Croats and Slovenes issued last year regulations concerning the growing of sugar beets, under which beet sugar cultivation in their territories was permitted solely for the production of sugar, any other use of sugar beet, as for alcohol or chicory manufacture, being forbidden under penalties. Growers also were compelled to sell their roots under contract to the local manufacturers, or, failing a contract, at the highest price at which the particular factory had already paid other producers. By these measures it was hoped that speculation would be prevented, and a supply of sugar for local consumption be assured.

Attention is called by H. THIEMANN⁴ to a process invented by engineers attached to the staff of the Krupp-Gruson A.-G., of Magdeburg-Buckau, Germany, for the recovery of coal and coke from furnace slag. It is based on the little-known fact that iron pyrites, lime and silicates become fused in the furnace into a mass consisting of iron oxides in various states of oxidation, holding lime and other silicates imprisoned, this conglomeration being magnetic. The process consists simply in spreading out the crushed slag, and separating the constituents by means of a suitable magnetic apparatus, the fine coal and coke left behind being again sent to the boiler room for feeding to the furnaces, while the purified slag is utilized for brick making. It is stated to be claiming the consideration of the beet sugar industry in Germany.

¹ *Archief*, 1919, 27, 1241-45.

² *Chemical Trade Journal*, 1920, 67, No. 1744, 533.

³ *Chemischer Zeitung*, 1920, 44, 657-658, 669-671.

⁴ *Facts about Sugar*, 1920, 11, No. 17, 330-331.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING DECEMBER 31ST.		TWELVE MONTHS ENDING DECEMBER 31ST.	
	1919. Tons.	1920. Tons.	1919. Tons.	1920. Tons.
UNREFINED SUGARS.				
Russia .....	....	....	....	....
Germany .....	....	7,206	....	13,171
Netherlands .....	....	....	1	....
Belgium	87	....	741	....
France	8	....	8	....
Austria-Hungary .....	....	....	....	....
Java	7,316	83,336	172,838	333,889
Philippine Islands .....	....	....	4,669	1
Cuba	41,115	10	587,252	506,611
Dutch Guiana	102	....	1,456	59
Hayti and San Domingo ..	....	....	....	14
Mexico .....	....	....	....	....
Peru	6,348	10,056	77,577	47,509
Brazil	744	4,406	6,971	12,163
Mauritius	24,786	17,000	153,682	142,894
British India	387	....	4,722	16,752
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	4,250	1,557	113,306	124,009
Other Countries	3,914	11,062	19,100	51,654
Total Raw Sugars	89,057	134,631	1,142,323	1,248,716
REFINED SUGARS.				
Russia .....	....	....	708	1
Germany	253	....	253	126
Netherlands	7,560	1	20,643	1,068
Belgium	1,615	10	5,532	2,126
France	10	....	33	25
Austria and Hungary	610	....	990	123
Java	6,130	1	117,060	5,014
United States of America ..	38,123	16	222,083	100,449
Argentine Republic	1	6	11	55
Mauritius	6,850	....	23,452	....
Other Countries	10,761	56	71,369	7,890
Total Refined Sugars ..	71,913	90	482,134	116,878
Molasses	16,416	5,131	127,389	72,684
Total Imports	177,385	139,852	1,731,846	1,438,278

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .....	....	....	....	....
Netherlands	1	118	2	678
Portugal, Azores, and Madeira	....	5	....	52
Italy .....	....	....	....	....
Canada .....	....	....	1	....
Other Countries	66	117	1,255	1,517
	67	240	1,259	2,248
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	146	6	3,900	6,448
Unrefined	377	51	33,986	9,919
Various Mixed in Bond .....	....	....	....	....
Molasses	1,045	275	9,234	4,006
Total Exports	1,635	572	48,379	22,631

Weights calculated to the nearest ton.

United States.

(Willott & Gray.)

	(Tons of 2,240 lbs.)	1920 Tons.	1919. Tons.
Total Receipts January 1st to December 30th ..		2,958,344	2,862,282
Deliveries		2,951,727	2,862,282
Meltings by Refiners ,, .. .		2,505,132	2,859,700
Exports of Refined ,, .. .		325,000	450,000
Importers' Stocks, December 29th .. .		7,888	—
Total Stocks, December 29th .. .		61,776	14,072
		1919.	1918.
Total Consumption for twelve months .. .		4,067,671	3,495,606

Beet Crops of Europe.

(Willott & Gray's Estimates to December 30th, 1920.)

	Harvesting Period.	1920-21. Tons.	1919-20. Tons.	1918-19. Tons.
Germany	Sept.-Jan...	1,150,000	739,548	1,350,665
Czecho-Slovakia	Sept.-Jan...	650,000	475,877	606,793
Hungary and Austria	Sept.-Jan...	50,000	41,132	
France	Sept.-Jan...	300,000	154,444	110,096
Belgium	Sept.-Jan...	250,000	146,918	74,183
Holland	Sept.-Jan...	300,000	238,692	173,436
Russia (Ukraine, Poland, etc.)	Sept.-Jan...	250,000	225,000	336,616
Sweden	Sept.-Jan...	164,772	145,000	127,467
Denmark	Sept.-Jan...	165,000	152,852	144,600
Italy	Sept.-Jan...	175,000	182,843	106,682
Spain	Sept.-Jan...	175,000	81,650	139,409
Switzerland	Sept.-Jan...	10,000	8,550	10,800
Bulgaria	Sept.-Jan...	10,000	10,974	2,441
Roumania	Sept.-Jan...	5,000	....	....
		3,654,772	2,603,480	3,183,188

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS
ENDING DECEMBER 31ST, 1913, 1919, 1920.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1919. Tons.	1920. Tons.	1913. Tons.	1919. Tons.	1920. Tons.
Refined	922,545	462,134	118,878	780	3,900	6,448
Raw	1,046,715	1,142,323	1,248,718	3,889	33,986	9,919
Molasses	163,062	127,389	72,684	357	9,234	4,006
	2,132,322	1,731,846	1,438,278	5,006	47,120	20,373
HOME CONSUMPTION.						
	1913. Tons.	1919. Tons.	1920. Tons.			
Refined	899,327	392,684	139,414			
Refined (in Bond) in the United Kingdom	715,661	835,756	785,140			
Raw	116,942	303,355	181,385			
Molasses	31,845	45,930	27,154			
Molasses, manufactured (in Bond) in United Kingdom ..	37,587	72,098	67,927			
Total	1,801,362	1,649,753	1,801,020			
Less Exports of British Refined	23,271	1,259	2,248			
	1,778,091	1,648,494	1,798,772			

Sugar Market Report.

Our last report was dated 6th December, 1920.

Official prices remained without change until 27th December, on which date the Royal Commission announced a reduction of 8s., to 7s. per cwt. duty-paid, for Granulated, Crushed and White Pieces, the retail price being adjusted as from the 1st January by a reduction of 1d. to 9d. per lb. Although any official information on the point is lacking, it is thought likely that the end of the financial year may be chosen as the time for relinquishing control, an opinion which is reflected in some small purchases of White Javas at about 36s. per cwt., c.i.f. U. K., due to arrive in February and March, evidently made by buyers who anticipate an early removal of restrictions and regard the risk of getting permission to land the sugar as a relatively small one.

The home markets have shown small signs of activity. Remnants of "free" white sugars appear now to have been absorbed. W. I. Crystallized descriptions have met a moderate demand, and are quoted at about 58s. to 62s., whilst good Muscovados are obtainable at 44s. to 45s., and low Syrups at 35s. to 36s. per cwt., duty-paid. Peruvian 96 per cent. Centrifugals have been offered down to 22s. 6d. f.o.b., Jan.-Feb. shipment.

A comparison of to-day's quotation of about 4.20 cents per lb., f.o.b., for Cuban Centrifugals with that ruling a month ago, would seem to indicate that the market has gained some amount of steadiness; the more so when it is considered that the value dipped in the meantime to 3.50 cents per lb., a price well below the present cost of production. Undoubtedly the attractiveness of the price induced a demand, resulting in the clearance of some 30,000 to 40,000 tons of the old Cuban stocks, but with the considerable quantity still to be disposed of, it cannot be said of Cuba that the end of her troubles is in sight. The much talked of financial relief from the United States is still absent, and the moratorium has perforce been extended for another month, to 31st January. Funds for current requirements may be derived from the working of the new crop, but the real position can only be revealed at the time when the remainder of the old crop has been finally disposed of. American and Canadian refineries are re-starting work, thus assisting in the movement of stocks.

As shown last month, America has little cause to fear any scarcity of supplies in the present year. For the near future, the stocks carried over at the end of 1920 are abundant, and whereas a year ago the domestic beet crop had been largely disposed of, only about one-third of the present crop has been sold. Consumption figures to the end of 1920 are not yet to hand, but it is to be expected that the low prices ruling and the plentiful supplies in sight will favour a substantial increase this year.

In Java, values have followed the general trend, and a considerable amount of business has been transacted, which, in the main may be said to have assisted in the direction of improving the position, and although finances in the East continue in a very unsettled state, there are factors which make the outlook for Java a little more hopeful. The Syndicate of Planters has disposed of its stocks of old crop sugars, which are now largely in hands unlikely to press them on the market. A few months still remain in which to deal with the balance of the old crop, during which any financial improvement may help to turn potential requirements of Eastern countries into actual demand.

So far shipments from Java have proceeded slowly. Under pressure of sales the price for White Javas fell rapidly until 14 guilders f.o.b. was touched, but a recovery set in, and to-day the market is reported firm at 23½ guilders per picul f.o.b. (say 35s. per cwt.). There is a demand for shipment to India, the quotation for Calcutta standing at 36s. 6d. per cwt. c.i.f., whilst European ports are quoted about 40s. c.i.f.

Continental crop reports are favourable, except those from Czecho-Slovakia, where disappointing outturns necessitate a reduction in the estimate for 1920-21 to 700,000 tons. Negotiations for the sale of 100,000 tons Czecho-Slovakian sugar to France have so far borne no result.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
8th January, 1921.


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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Future of the Royal Commission.*

Up to the time of writing (February 10th) no definite pronouncement regarding the future of the Royal Commission for the Sugar Supply has been made to the public, though it is believed that some such announcement is imminent, and will in any case be made ere this month has run its course. It is not even now a foregone conclusion that the Royal Commission will go entirely out of existence just yet, though opinion inclines to the probability that it may do so at the end of the official financial year (the end of March). Certainly we may expect some radical change in the restrictions at present ruling in the matter of imports into this country; whether the Royal Commission goes out of office next month or continues to exercise a light supervision of the sugar trade for a few months longer, it is fairly safe to assume that within a month or six weeks a much freer permission to import sugar will be granted. The belief in this intention has been strong enough to warrant certain manufacturers buying some parcels of Continental sugar for forward delivery after the restrictions are expected to be lifted.

As we have previously mentioned, the demise of the Royal Commission must preferably be timed to take place so as to cause the least possible trouble to their successors; consideration has therefore to be shown in regard to existing stocks of raw sugar which the Royal Commission have bought here or there, and which have either yet to be landed or to be passed on to the refiners. Actually it has been estimated that they have on their hands sufficient quantities of raw sugar to last almost six months, or say till July.¹ It may be assumed then that they are anxious to assure themselves that this sugar will be taken up by the refineries on mutually advantageous terms, and that this sugar will be disposed of by the refiners ere the latter embark on the unrestricted purchase of fresh supplies. If a sufficiently satisfactory arrangement is come to between the Government and the refiners in this country, the result will be that no great market for imports will exist in this country for some months, and what market develops will only be due to keen competition of lower prices.

¹ They have just bought on favourable terms 100,000 tons of Cuban raws.

The official figures of the Board of Trade for 1920 gave the consumption for that year in this country as 1,198,772 tons, or much the same as in 1917 and 1918, but considerably less than in 1919, when it was 1,649,645 tons. Two factors tended to account for the reduction; firstly and chiefly the restricted allowance rationed to the consumer as compared with 1919, and secondly the restricted buying towards the end of the year, when the public purse could not or would not respond to the offer of the Government to let the consumer buy more if he wanted. A year ago it was expected that 1,100,000 odd tons would be the amount of the consumption in 1920; the total actually was about 100,000 tons more. As for the 1921 consumption, it is unlikely that it will exceed if indeed it attains to the 1919 figures, for while sugar is plentiful enough to provide that tonnage, the price of sugar is still too high, being about four times the pre-war price, while the buying public, or rather the poorer members who form the bulk of the population, have no longer the means to spend freely, and the large percentage of unemployment existing this winter will have its effect on the purchasing power of the public.

The American Sugar Consumption, 1920.

Writing on January 13th last, Messrs. WILLETT & GRAY estimated the consumption of the continental United States for the year 1920 at 4,084,672 long tons refined or consumption value, an increase over 1919 of 17,001 tons or 0.418 per cent. Since then, however, Mr. M. P. WILLETT has calculated that the consumption was more nearly 4,075,173 tons consumption value, as compared with 4,126,673 tons in 1919, an actual decrease of 51,500 tons. He puts the per capita consumption therefore at 86.35 lbs., as compared with 87.45 lbs. in 1919.

The same writer in the *American Sugar Bulletin* states that "the feature of the year was the heavy importation of Java and other sugars which pay the full tariff rates upon entering the United States. These sugars were received in such large quantities during the last half year that not all of them could be consumed within that period. The receipts of such sugars were 850,503 tons, compared to 73,822 in 1919, the consumption 704,787 tons, the carry-over at the end of the year 104,821, and the exports 44,866 tons. Only one-fourth of these full duty sugars reached the United States before July 1 and practically all exports were made during the first half of the year. The exports since July 1 have been very light owing to the agreement between refiners and the Government to limit them so that American consumers might have a full supply. The demand for this large amount of full duty sugar was caused by the heavy consumption of United States cane and beet sugar in the fall of 1919 and the decrease in the Cuban crop of 1919-1920."

The consumption of domestic sugars during 1920 was unusually small, due in part to small stocks at the beginning of the year and in part to a reduced consumption towards the end, while the output of both domestic cane and beet was greatly increased, beet in particular increasing as compared with 1919 by 251,384 tons. The result has been a large accumulation of sugars at the end of the year, amounting to 1,093,545 tons. "The beet stock alone is 410,053 tons greater than last year, the domestic cane stock 80,293 tons greater, and the stock of imported sugar only 225,516 tons greater. This stock is about equal to the old crop Cuban sugar still held on the island of Cuba, and is therefore by no means excessive. The total stock while it exceeds that at the opening of last year by 718,434 tons is less than 400,000 tons above a normal stock of about 700,000 tons."

The Future of the British Sugar Beet Growers' Society.

The British Sugar Beet Growers' Society, which was registered in 1916 under the Industrial and Provident Societies Acts, with rules prohibiting the division of profits among the shareholders, has now transferred its responsibilities for the Kelham sugar growing enterprise to Home Grown Sugar, Limited, and thus enters upon a new phase in its career. Obviously the creation of a single factory cannot exhaust the Society's ambition or utility. The home production of sugar has a vast scope for development, and the future object of the Society must be to continue its work so that the benefit of this industry may be extended to many other English counties. We understand that it is proposed therefore to re-organize the Society on the following lines:—

Two classes of members are to be invited to join: (a) Grower Members, who have grown and harvested, or intend to grow and harvest within three years at least one acre of sugar beet; and (b) Guarantor Members, being other persons interested in the progress of the industry. The former will pay a minimum subscription of 10s. per annum, while the latter will guarantee a sum in multiples of £50 payable in calls of £10 at a time. Then the Development Commissioners are to be asked to make a grant to the Society's funds on conditions to be agreed upon, say £1 for every £1 of the Society's income from grower members.

The future objects of the Society will be (1) To encourage the growth of sugar beet by farmers in the United Kingdom in areas contiguous to a factory. (2) To get into touch with all movements in favour of the home production of sugar in any part of the United Kingdom. (3) To consider the advisability of forming a company to acquire land for the production of sugar beet as reserve supplies for beet sugar factories built or contemplated. (4) To consider the promotion of a further beet sugar proposition ready to go forward as soon as the Kelham scheme has been proved. (5) To continue the journal *Home Grown Sugar* as a medium for information and for the dissemination of news in respect to the beet sugar industry. (6) To prepare and publish literature dealing with each technical aspect of the industry. (7) To appoint a panel of lecturers and agricultural advisers to speak at meetings and correspond with members on technical questions. (8) To consider the establishment of a Seed Station with a view to making the industry ultimately independent of imported seed. (9) To assist sugar beet growers and beet sugar manufacturers in approaching His Majesty's Government on questions which affect their interests in connexion with the establishment of the industry.

It may be added here that the Society in transferring its financial interests in Kelham to the new company—Home Grown Sugar, Ltd.—only retained a cash sum of £7 18s. representing its share capital of 158 shares of 1s. each. A new Guarantee Fund is, however, in existence, which amounts already to £2300, of which £810 has been called up. There are therefore sufficient funds to enable the Society to continue its activities as outlined above.

The Kelham Plans.

As regards the Kelham sugar factory of Home Grown Sugar, Ltd., it is intended that the first campaign shall take place in the autumn of 1921, when the factory is expected to be complete and in operation. An expert beet contracts manager from Canada has been appointed with English farmers as his assistants, and contracts are already being secured for the coming season. A large acreage on the Kelham Estate is being prepared for beet by the estate manager, not less than one-third of the arable land. The factory walls are already rising, and the silos, siding

and wharf are well advanced. The machinery contractors, the Compagnie de Fives-Lille, of Lille and Givors, France, commence delivery of the machinery this month for transport to Newark by river and rail from Hull, and French artificers are being sent over to supervise its erection. An expert French factory manager has been appointed, who has already selected his expert foremen for the various processes, under whom English workmen will be trained.

The Modernizing of the Philippine Sugar Industry.

In our Notes and Comments of last month we drew attention to the rapid strides being made in the sugar industry of the Philippine Islands and their great inherent fertility and suitability for the growth of the sugar cane. In an article by JAMES SCOTT which appeared in a recent number of *Sugar*¹ some details are given of the new concerns being erected in these islands by American capital. It has been obvious for some years that no real progress could be expected until there was sufficient confidence established for the production of this capital, and from the details given by Mr. SCOTT it is evident that this stage in the progress of the colony has at length been reached. The sugar industry has, according to this writer, entered on a new phase of life during the past three years, and is proceeding by leaps and bounds beyond the most sanguine expectations. It is true that this is largely due to the high price of sugar after the war, but some such condition has been prophesied for years back. Since February, 1919, hardly an American ship has arrived but with its quota of sugar machinery, and a serious glut of this machinery has been caused at Iloilo, the second port in the Philippines, by the unusually severe typhoon season, which has prevented its rapid distribution by small vessels to its destination. A new pier, one and a half miles in length, is being rapidly thrown out into the sea and considerable lengths of railway are being pushed on to reach the estates.

The 1920 crop saw four new Centrales at work for the first time and five more are expected to tackle the 1921 canes. The four completed were Del Carmen, in Luzon, with a capacity of 1500 tons of canes daily, and the other three in Negros, La Carlotta and De Bais for 1000 tons daily, and one in the Isabella Valley for 700 tons. The writer enters into considerable detail regarding the erection of the De Bais factory, in a part of the country where the cane planters are noted as extremely conservative. The various unexpected obstacles met with would have seemed to many as prohibitive, but they were all successfully overcome, and the latest news is that the factory is working smoothly, in spite of the facts that the staff is untrained and the planters seem to have little conception as to what 1000 tons of cane a day mean.

The five Centrales being erected are in the same two islands, four in Negros and one in Luzon: two of them will deal with 1500 tons of cane daily, and one each with 1200, 1000 and 600 respectively. Much assistance is being rendered by the newly founded Manila branch of the Honolulu Iron Works, where very large sums are being invested so that all the machinery of a new Centrale can be made to its smallest detail. An order has already been placed by La Carlotta for the duplication of its equipment, so that it can deal with 2000 tons of cane daily. The question of trained assistance is a difficult one, and the resources of the Hawaiian Islands have been rather unduly drawn upon. But it is hoped that the newly started Sugar School in Manila will be able to reduce this shortage as the industry expands. There are of course, as usual, labour difficulties, and every effort is being made to reduce the number of men required in the field and

¹ "The Modernizing of the Philippine Sugar Industry." *Sugar*, 1920, 430-441.

Notes and Comments.

factory. It appears to be the custom of the Filipino to desert the plains for the hills at the first onset of the rains, in order to sow his corn; and the writer states that he often does not return until the crop is reaped and there is practically nothing left for him to eat. As long as he has his supplies of food he, perhaps naturally, prefers to remain inactive, as is the case in most tropical countries.

Sugar Cultivation Anew in the Federated Malay States.

Notwithstanding the extraordinary prosperity which has attended the plantation rubber industry from its inception down to recent years, the continued expansion of planting in the Eastern tropics has been responsible for a strong feeling of apprehension amongst those whose business it was to take long views; and although it is fashionable to deride warnings on the danger of overplanting there has always been a substantial body of opinion in favour of the cultivation of other crops and the limitation of the planting of rubber. While rubber continued to command high prices in the world's markets, there was a tendency to cut out tea, coffee and coconuts, a tendency which was spreading to the small cultivators; but for some years the authorities in the Federated Malay States have endeavoured to discourage this policy and to direct attention to other forms of tropical agriculture likely to prove remunerative and for which the soil of Malaya is suitable. For it has been evident that if anything should occur, either by way of bad markets or a spread of disease to the rubber estates, the result would be bound to be serious to those who had embarked capital in the industry. While it would be unfair to state that these warnings went altogether unheeded, it is nevertheless a fact that too little weight was given to them; and it has required the present slump in rubber to awaken some people from their self-satisfaction and force them to devote their thoughts to cultures other than rubber.

In a recent memorandum laid before the Federal Council of the Federated Malay States, the High Commissioner (Sir LAURENCE GUILLEMARD) reviews some of the activities of the Agricultural Department during the past year. One of its most welcome features, he says, was the increased interest displayed in other major tropical cultivations, particularly the African oil palm and the sugar cane. Sugar was at one time grown more or less extensively in the Malay Peninsula, especially in Province Wellesley and the State of Perak, and it is just possible that, given favourable economic conditions, it may again become one of the main products of the Peninsula. A number of applications for land for sugar cane cultivation on a large scale have been received by the F. M. S. Government, and we gather that a committee has been appointed to advise with regard to the need for Government encouragement and the best forms this should take.

City and Guilds of London Institute's Examinations.

Notice was recently called to the Examination in Sugar Manufacture conducted by the City and Guilds of London Institute, which is regarded as a useful qualification for the young sugar chemist. Intending candidates are reminded that the next examination will take place on Tuesday, April 26th, 1921, and that they should make their entries by March 9th, addressing them to the Secretary of the nearest technical school. If candidates are in doubt as to where they should apply, they should communicate with The Superintendent, Department of Technology, City and Guilds of London Institute, Exhibition Road, London, S.W. 7, who will inform them of the nearest centre at which their entry would be accepted.

¹ *I.S.J.*, 1920, 439-440.

Fifty Years Ago.

From the "Sugar Cane," February, 1871.

DUBRUNFAUT published in this issue of our predecessor an article on what he termed *melassimetrie*, which he defined as the art of determining from the analysis of a raw sugar the amount of molasses that one may expect to obtain from it during refining. He had assumed that glucose prevented the crystallization of an equal amount of sucrose; while the co-efficient for the ash was believed to be 5. Analyses of the final molasses obtained from several different French refineries were here published, and figures stating the amount obtained were also given. These data were concluded to offer very good proof on the whole of the veracity of the assumptions made, it being remarked that "except the molasses of MM. SOMMIER & C^{ie}, which is of exceptional composition, the molasses in the table differ very little, and if we apply the salts to the crystallizable sugar alone we shall find very nearly a justification of the co-efficient 5, which is imposed by the refiners on the manufacturers of (beet) sugar. But if we take account of the glucose there will remain different saline co-efficients of the crystallizable sugar, according to the figure allowed for the glucose co-efficient. With the glucose co-efficient 1, the saline co-efficient is about the figure 4; with the glucose co-efficient 2, the saline co-efficient of the crystallizable sugar approaches nearly to an average of 3.5, which appears to us to belong to raw molasses." It is worth while quoting the average analysis stated for the refinery molasses of that day, namely, density; 40.2° Bé. (75.7 Brix); sucrose, 39.66; glucose, 19.23; and ash, 5.80 per cent.

In the determination of the glucose in these analyses of molasses, two methods had been used, viz., the copper test, and the sucrate of lime process. This latter method had been elaborated by PELIGOT, and in another part of this issue of the "Sugar Cane" an extract from the book entitled "*Saccharimetrie optique, chimique, et melassimetrique*" by the ABBOT MOIGNO giving details was reproduced. Briefly the procedure was to add quicklime to a solution containing 10 grms. of the raw sugar under examination, triturate it in a mortar, filter, and titrate the filtrate by means of a standard solution of sulphuric acid, using litmus as indicator. In the analyses cited, the results obtained by this method differed a good deal from those found by the use of the Barreswil liquor, being generally much lower.

Another paper on the analysis of sugar discussed the question of the absorption of sugar by animal charcoal when this decolorizing agent is used to supplement the effect obtained by clarifying with basic lead acetate for the preparation of the solution for polarization. It was by STAMMER; and he showed conclusively that, contrary to the opinion of that time, a rather considerable error may be produced in this way. Powdered char, dried at 230°F. was used at the rate of about 5.5 grms. to 100 c.c. of a normal weight solution; and the average decrease of polarization observed after 3 hours' contact in the case of raw sugars was 0.4 per cent. In a note to this paper by STAMMER, the Editor of the "Sugar Cane" remarks that English chemists were well aware of this source of error; and that, moreover, they had observed that if the solution to be treated were run through animal charcoal it is only the first portion of the filtrate that will be affected. In the analysis of raw sugars, therefore, the liquid was clarified with basic lead acetate, made up to volume, passed through 130 c.c. of new char of 16 × 20 grist, and the first 75 c.c. of the filtrate rejected.

On the Viability of Sugar Cane Pollen.

During the early years of the Coimbatore Cane-breeding Station in South India, before a sufficient number of cane varieties had been collected or those present had been induced to flower by planting them at a special time of the year, attempts were made to import pollen from a distance for dusting on the cane arrows on the farm. For this to be done with any certainty of success, it was necessary in the first instance to obtain some ideas to the viability of the pollen, that is to say its capacity for independent life, and the length of time during which it retained this capacity. The cane pollen thus received a measure of study, but, owing to the great congestion of work during the short period of cane flowering, when the seedlings for the year had to be raised, no great amount of time could be devoted to this special piece of work. In fact, it proved to be more arduous than anticipated in that unexpected difficulties arose. It was found very hard to make the pollen grains germinate, and they were found to be unaffected by the ordinary media used for the germination of the pollen of other plants, and such a protrusion of the pollen tubes was necessary to determine the keeping qualities of the pollen sent by post. Some small success was ultimately obtained by sowing the pollen upon the stigmas of wild plants growing in the neighbourhood, and the prickly pear and Portia tree (*Thespesia populnea*) were found to be the best for the purpose. Later, infusions were used from the crushed stigmas of these plants and it was surmised that the pollen of *Saccharum spontaneum*, alone available at the moment, retained its viability for a much longer period than had been suspected.¹ After fourteen days some of the pollen grains were seen to protrude their stigmas in this medium, but there was some doubt as to whether the tubes were altogether normal. The matter was perforce left in abeyance when the station became self-contained in the matter of flowering and vast numbers of seedlings were easily raised, as is recorded in the various Memoirs and other publications issued by the workers on the farm. It was always, however, held in view as a subject which required to be threshed out when the time could be spared for it, and it is with pleasure that the writer has recently received a letter from Mr. T. S. VENKATARAMAN, the officer at present in charge of the Cane-breeding Station, that he had again returned to the subject and had met with a further measure of success. Mr. VENKATARAMAN writes under date of 16th November, 1920, as follows:—"This year I wished to be able easily to germinate sugar cane pollen, because all pollen preservation experiments depend, in the first instance, on our having a reliable test as to its viability. Dissatisfied with culture media, I again turned my attention to a systematic trial of all available stigmas, and this study resulted in the discovery that on *Datura fastuosa* var. *alba* and *Hibiscus vitifolia* germination of cane pollen was very satisfactory, as one can often meet with as many as eight or ten pollen tubes in the field of vision under the microscope. Working with this test, it is found that, under ordinary conditions, the cane pollen loses its viability in less than an hour, there being slight variations according to the variety of cane. By designing a special chamber, I have so far succeeded in keeping the pollen living for as long as four hours in certain cases. As this time was insufficient for our purposes [presumably the keeping of selected pollen for use on several successive days or sending it by post], I tried to prevent the pollen sacs themselves from bursting, for they are chambers provisioned by nature, and I am glad to be able to report that, by erecting special

¹ C. A. BAEHR. "Studies in Indian Sugar Cane, No. 2." *Annals of the Department of Agriculture in India. Botanical Series.* Vol. VIII, No. 3, July, 1916.

crates over the whole cane with its arrows, I have been able to keep the pollen viable for as many as six days. This opens up the possibility of arranging crossings between stations separated by a railway journey. Non-viable pollen is easily distinguished from viable by its germination on *Datura stigmas*, which are available in quantities at the time when the canes arrow. . . ." In a letter of the 3rd December, 1920, Mr. VENKARATAMAN informs the writer further that he has succeeded in extending the period of enforced viability to a fortnight.

It might be suggested that further studies should now be made as to the validity of the testing of the fertility of cane ovules by the presence of starch in the styles. The discovery of this method was made some years ago by Mr. VENKATARAMAN,¹ but from recent conversations with Java botanists doubt has been thrown on its universality, and it is a matter of very considerable importance for those engaged in raising seedling canes with known parentage.

C. A. B.

Sugar Cane Cultivation in Antigua.

Now that the success of the Gunthopos Central Factory is established, and the great bulk of the sugar made in Antigua is prepared by modern machinery, it is natural that increased attention should be made to ensuring the necessary quantity of canes for the full working of the mills. The various processes in the manufacture of sugar have reached some degree of perfection, but this can hardly be claimed for the cultivation in the fields: it is very rare that factory and field receive equal attention in sugar cane countries, and it is obviously now the turn of the fields. And there are special reasons why this should be the case in Antigua: a large part of the cane area has a very heavy clay soil, and the amount of rainfall is, to say the least, somewhat meagre; and the recent fall in the price of sugar makes it all the more important that sufficient canes should be grown for the factories, so that these successful installations should be able to meet the time of stress which has so suddenly come upon the industry. An important section of the Annual Report of the Antigua Agricultural Department for 1918-19 deals with this subject, showing that the local authorities are fully alive to the importance of this aspect of the question. For those who have not visited or worked in the West Indian Islands it is somewhat difficult to understand the extreme diversity of the various islands in their agricultural conditions. Perhaps no three sugar growing countries close together could be selected, where these conditions are more different, than Antigua, St. Kitts, and Barbados, and Antigua is easily the worst off in most respects. The character of the soil in most parts has already been alluded to as well as the meagreness of the rainfall. For a country subjected to the stiff breezes of the North East trade wind for most of the year, an annual rainfall of 60 to 70 ins. would not be out of place for the sugar cane, but we see that it is stated in the report that, for the past 45 years, the average has been slightly under 45 ins.: this means of course that, on the average, in alternate years less than this amount falls. The island, as is well known, experiences occasional severe droughts, when it is even difficult to get water for drinking for men and beasts, and much more so for the successful cultivation of the heavy clay soil. If the island had not been under cane for something like 300 years, it is doubtful whether any one would have chosen it for the purpose.

¹ T. S. VENKATARAMAN. A study of the arrowing of the sugar cane. Being a paper read at the Bangalore meeting of the Indian Science Congress. *Agricultural Journal of India*. Special Congress Number, p. 105.

Sugar Cane Cultivation in Antigua.

The methods evolved are somewhat peculiar and generally successful but, with the increasing scarcity of labour, they are fast becoming difficult, and the Report under review takes a somewhat serious view of the new conditions thereby arising.

In the absence of any means of artificial irrigation, the only way of eking out the often scanty rain supply is by conservation of moisture in the cane fields: this can be done, it is pointed out in the Report, by deep ploughing, dust mulch and heavy manuring (presumably with cattle manure). As many of the cane fields are now steam ploughed, a sufficient depth can be easily obtained, but there is none the less necessity that this depth should be very gradually reached for fear of bringing the infertile layers to the surface. The conservation of moisture is the crux of the whole matter, for the constant working of the surface layers needed for this cannot be undertaken by the diminishing labour supply. The cane fields are "cross-holed" or if they are not are "cross-banked," so that the use of horse-drawn implements is practically ruled out. The system of cross-holing is described as follows. After the land is ploughed and the banks and furrows formed, baskets of manure are dropped at intervals into the latter, and these heaps are covered by earth drawn partly from the banks and partly from the furrows: by this means a series of ridges, or "bars" as they are called, are formed at right angles to the line of the furrow. And when cross-holing is not practised, a series of beds are formed with much the same result. Interculture with horse-drawn implements is thus impossible without throwing down the earth from the ridges or raised beds on which the canes are planted. Now, as pointed out, this method is age-long, and it is always a very risky process to alter any such ancient practice. The suggestion is made in the Report that the only way to overcome the difficulty is to have rows, furrows, drains all in parallel lines. One of the adverse factors in the climate is that the rain sometimes falls in very heavy showers, and this rain must at all costs be got off the heavy land as soon as possible, so we have the rival aims of conserving the moisture and yet getting rid of it quickly when in excess; and to meet this the suggestion is made that no deep furrows should be made where the water can lodge. We presume that the local agricultural officers have laid down the necessary experiments to test the possibility of this important innovation.

Green manuring has received a considerable amount of attention in the past in Antigua and we see that, in 1910, 640 acres were thus treated; but the practice has not apparently been free from difficulty, for it is reported that perhaps less than one-third of this area is now under green manuring crops. This is unfortunate for we should have felt inclined to emphasize its importance by including green manuring among the three methods mentioned above for the conservation of moisture in the cane fields. A number of leguminous plants were found to grow freely in Antigua, but most of them were liable to severe insect attacks; this appears not to be the case with the "Barbuda bean" (*Phaseolus lunata*) and this is the one recommended to the planters. One of the difficulties in growing such a crop before the time for cane planting is a lack of fodder at this dry time of year, and on this account ratoons are often allowed to sprout for being fed to cattle. It is suggested in the report that there should be an extension of the use of the silos, already practised in some parts, as these could easily be filled with the surplus of cane shoots available at harvest time. If the ratoons were got off the ground quickly, there would be plenty of time for the growth of a green manuring crop and the subsequent preparation of the land for the next crop of canes. There is no doubt as to the benefits to be derived from this practice if carried out on sound lines, for one of the immediate results would be a saving of cattle manure as far as its main characters

are concerned. All of these troubles would be doubtless solved if there were abundance of this valuable manure, but unfortunately this is far from being the case. The subject is briefly alluded to in the report and the suggestion is made that, to increase the supply, fast growing grasses such as Kaffir corn or Sudan grass, together with a balancing ration of cow peas, should be thrown into the pens daily in such a quantity as to more than suffice for the cattle to eat, the residue thus being available for the increase in bulk of the cattle manure. It is pointed out that it is not good practice to use artificials when a good supply of cattle manure has been given to the land, but that a couple of cwt. of ammonium sulphate are required to start the ratoons immediately after harvest. The Antigua problem is thus seen not to be an easy one to solve, and it will be interesting to follow the results obtained.

Lastly, in the work of the local Agricultural Department in another portion of the report, the subject of a suitable rotation is discussed. Although often brouched, this factor in soil improvement has apparently never been really tackled in Antigua, and it is interesting to note that a series of permanent plots have been put down on Cassada Garden estate under different rotations, together with another set with different quantities of lime. The following are the rotations suggested:—

- (1) Plant cane; 1st ratoons; 2nd ratoons.
- (2) Plant canes with a catch crop of maize; 1st ratoons; 2nd ratoons.
- (3) Plant canes; 1st ratoons; 2nd ratoons followed by sweet potatoes.
- (4) Plant canes; 1st ratoons; yams.

We presume that the advantages of green manuring have already been tested, but are rather surprised that this does not find a place in (1) and (2). The limed plots are at the rate of 1, 2 and 4 cwt. the acre; each plot is in two parts to one of which lime is applied, while it is absent in the other.

C. A. B.

The Mosaic Disease of the Sugar Cane in Trinidad.

Further details regarding the presence of the Mosaic disease of the cane fields in Trinidad, referred to briefly in the December number of this journal (p. 669), are given by C. B. WILLIAMS,¹ the Entomologist in charge of Frog-hopper Investigations in that island, from which it is seen that the disease is fast assuming alarming proportions and that at least fifty centres of infection have been located. He reports as follows:—

“Early in 1918 a plot of canes of the variety D.3956 at the St. Augustine Experiment Station was noticed to have the leaves streaked with pale yellowish green. A year later the same unusual appearance was apparent, if anything more pronounced, but nothing similar was noticed on the neighbouring beds.

“Towards the end of 1919 I pointed out the conditions to Mr. W. NOWELL, Mycologist of the Imperial Department of Agriculture, who was in the colony, and we discussed the possibility of its being the Mosaic disease. A little later a close search revealed the fact that many other varieties were infected to a greater or less degree, and as a precaution no further cuttings were sent out from the station.

“Specimens dried and in formalin were sent to Mr. M. A. TAYLOR, Chief of the Bureau of Plant Industry, U.S. Department of Agriculture, who replied in March, 1920, as follows:—

¹ C. B. WILLIAMS “The Mosaic Disease of Sugar Cane in Trinidad.” *Bulletin of the Department of Agriculture, Trinidad and Tobago*. Vol. xix., part 1.

The Mosaic Disease of the Sugar Cane in Trinidad.

"Dr. E. W. BRANDES, Pathologist in Sugar Plant Investigations, whom I asked to examine this material, advises me that there can be no question but that the dried and formalined specimens are affected by sugar cane Mosaic. He would not make this diagnosis solely on the dried material, but the leaves in formalin show the typical condition induced by the disease. The importance of prompt and thorough action with respect to its eradication, if it is not too firmly established, is considered by our pathologists to be very great. . . . Dr. BRANDES advises further that the cane varieties which you mention being diseased in Trinidad are all included in his notes on observations in Porto Rico and Louisiana, made during his trip to those regions last year. Furthermore, all Trinidad seedlings, including T.247, T.24, T.87, T.83 and T.211 are badly affected in Louisiana. Whether this indicates that these varieties were diseased when they reached Louisiana, or are especially susceptible and became quickly infected after arrival, cannot be determined from the information available here."

"Shortly before the receipt of this confirmation of our suspicions as to the identity of the disease, the situation had become much more serious in Trinidad by the discovery that many of the cuttings already sent out from the Experiment Station were infected and were producing diseased plants which would become centres of infection. A number of estates were visited in different parts of the island where cuttings had been sent, and in nearly every case the disease was found to be present to a greater or less extent.

"In April, 1920, the disease was proclaimed under the Plant Protection Ordinance . . . which gives the inspectors under the ordinance the right to enter estates for the purpose of searching for the disease, and of taking steps to destroy the infected plants if the owner of the canes does not do so after an order has been served upon him.

"At present there are about 50 known points of infection in the island, which are being dealt with as rapidly as possible. Several have already been cleared as far as visible signs can be depended on. Nearly all of these points of infection can be traced to cuttings sent out from St. Augustine, but there are a few the origin of which is uncertain. The most important of them is at River Estate, where a number of infected stools have been found. Sugar cane experiments were carried out at River Estate by the Board of Agriculture before they were transferred to St. Augustine, and it is possible that the occurrence of the disease at River Estate indicates that it was introduced into the island shortly before the transfer of plants from River Estate to St. Augustine in 1914. In the St. Augustine district a number of small farmers' plots seem to have become infected by the natural spread of the disease."

The disease appears to be wide spread on the St. Augustine Experiment Station, and 28 varieties are mentioned in a table of which D.366 alone was un-attacked. In an attempt to estimate the extent of the infection, it was found to range from 3.4 per cent. to 77 per cent. in the different varieties, and the damage done by loss in weight from 0.41 per cent. to 36 per cent., while H.146 showed a slight increase. Experiments have now been undertaken at St. Augustine's on the lines laid down in Porto Rico for testing the results obtained in that island. The note concludes that the disease is a serious one, and calls on the farmers, overseers and managers to assist in stamping it out, or at least keeping it in check. Considering the large development of cane-farming in Trinidad, the result of this propaganda will be awaited with interest. A special danger in a disease of this kind exists already in the island in the presence of froghoppers, and their connexion with the Mosaic disease will doubtless be carefully studied, and will tend to throw much light on the suggested insect transmission of the

Notes on American Sugar Production.

From our American Correspondent.

While the attitude of the sugar trade in general is still decidedly pessimistic, there are unmistakable indications that raw sugar prices have struck bottom as a result of the long and precipitous decline since last June and that a general improvement in market conditions is on the way.

The raw market has displayed steadiness, if no great amount of strength, for the past three weeks, and, in fact, there has been a slight recovery from the low point touched in mid-December, Cuban 96° test centrifugals selling now at 4.50 cents, cost and freight (2½d.) equivalent to 5.52 cents (2¾d.) duty landed. Refiners are buying more freely and meltings are rising in weekly volume, reflecting the improved demand for refined grades for immediate delivery. Fine granulated is now quoted wholesale by the refiners at 7.75 cents, and it is regarded as probable, unless a rally in raw prices sets in, that a further reduction to 7.50 cents (3¾d.) a lb. will take place shortly, as the margin between the prices of raws and refined still shows more than a normal spread.

In the expectation of a possible reduction in refined quotations, the distributing trade is buying only to cover day-to-day requirements, but this buying is becoming much more brisk than heretofore, indicating that supplies in the hands of dealers and consumers are nearly exhausted. As soon as consumers are convinced that the low mark in the price of refined sugar has been reached, it is believed that a marked expansion in the buying movement will be observable.

The amount of sugar carried over the turn of the year, mainly in the hands of refiners and producers, was roundly a million tons, which is a much larger supply than has been available at the beginning of a twelvemonth for several seasons past. The greater part of this is beet sugar, no more than 20 per cent. of the crop having been marketed prior to January 1st. A few beet factories are still in operation, and the campaign will not close before the end of the month, the quantity of roots to be sliced being greater than ever before. From present indications the final output of the beet sugar factories will be somewhat in excess of earlier estimates, being somewhere in the neighbourhood of 990,000 (long) tons.

In 1919 the Louisiana crop was marketed practically as rapidly as produced, and little of the crop, except second and third grades, remained in hand after the close of the campaign. This season, however, less than half the crop had passed into channels of distribution on January 1st, and its movement continues slow. As nearly all Louisiana producers will show a net loss on the season's operations at present prices, the smallness of the crop—probably 135,000 to 140,000 tons—is less a matter of regret than otherwise would have been the case.

The size of the Cuban crop now beginning is naturally a matter of interested speculation among members of the trade, in view of the important influence it will exert upon prices and market conditions. The difficulty of forecasting the probable outturn is indicated by the reluctance of recognized authorities to commit themselves to definite figures. While GUMA-MEYER have put out a tentative estimate of slightly less than 4,000,000 tons, HEMELY has contented himself with the statement that the cane supply is sufficient to produce 4,051,000 tons of sugar, but that the actual result of the grinding campaign is problematical.

Opinion in trade circles here leans decidedly to the opinion that Cuba will produce much less than 4,000,000 tons of sugar this season. This is not primarily on account of the financial and economic difficulties of Cuba, although it is recognized that these will tend to reduce the output. Greater importance is placed

Notes on American Sugar Production.

on the belated start of the grinding campaign. Only a score of mills were in operation at the end of December as compared with about 100 at the corresponding date of the previous year. The continuation of warm rainy weather beyond the usual advent of the dry season has kept the cane green and immature. At present low prices there is no inducement to mills to grind this unripened cane, which is naturally of low sucrose content. It is an axiom among Cuban sugar men that time lost at the beginning of a campaign is never made up later. As a consequence, the opinion is expressed by men who are in close touch with Cuban conditions that the crop will not run above 3,600,000 tons, or certainly not above 3,750,000 tons, which was the estimate of *Facts About Sugar*, on December 1st. Some Cuban producers assert that 3,200,000 tons is nearer the figure which will be shown by the completion of the harvest.

If these estimates of Cuba's output prove correct, if Europe again takes practically one-third of the Cuban crop, and if, as now anticipated, very little full duty paying sugar is imported into the United States during the present year, this latter market will be called upon to absorb about 4,000,000 tons of sugar, which is no more than its normal consumption. Statistically considered, the outlook from the producers' viewpoint is by no means discouraging. It is recognized that the coming crop will be produced at a lower cost than the one just completed, but producers naturally are not reconciled to the necessity of accepting a heavy loss on the old crop supplies remaining in their hands.

The long drawn-out Cuban moratorium has made itself felt here, not only in the sugar trade, but also among manufacturers of sugar mill equipment, many of whom have hundreds of thousands of dollars worth of machinery in Cuba on which they are unable to realize. Many of these large manufacturers have been seriously embarrassed by this condition, and have been forced to curtail their operations drastically. Consequently they have received with approval the action of the Government in sending Major-General CROWDER to Cuba, as it is understood that his going marks the adoption of a more vigorous policy on the part of the United States in dealing with the confused political and financial situation in the Island. It is generally believed that Major-General CROWDER will be able to exercise the pressure necessary to bring the contending political factions to some agreement and that this will pave the way to the adoption of measures which will make it possible to bring the moratorium to an end within a reasonable time.

Various committees of Congress are beginning work on a new tariff bill which probably will provide for a general increase in import duties. This undertaking is attracting less interest among sugar men than ordinarily would be the case, because it is recognised that an advance in the import duty on sugar is almost inevitable in view of the announced purpose to increase the federal revenue from this source. Current expectation is that the duty on 96° test centrifugals will be restored to 1.685 cents a lb., which was the rate in effect before the reduction in 1914. Allowing for the preference extended to Cuba under the reciprocity treaty this would make the duty on Cuban centrifugals 1.348 cents a lb. Sugar yields more revenue than any other single commodity on which a customs duty is imposed, the income from this source amounting to \$68,000,000 in 1919, and it is possible that the desirability of increasing the customs revenues as much as possible may lead to the adoption of a rate somewhat higher than that mentioned. Some advance in the import duty there assuredly will be, as the incoming Republican administration is committed to it.

New York, January 12th, 1921.

The Cost of Production of Sugar in Java.

By H. C. PRINSEN GEERLIGS, Ph D.

In the *International Sugar Journal* in 1914 we gave (on page 327) the net cost of all assortments of Java sugar, exclusive of interest on capital or renewals, for the years 1900 to 1913, the figures oscillating between 7s. 7½d. and 8s. 11d. per cwt. For 1914 we calculated the average net cost still at 8s. per cwt., while in 1915 it rose to 8s. 9d.

During the difficult war years, 1917 to 1919, we could not secure satisfactory estimates, so we now make use of the data of a very large concern, owning a great number of factories, which estimates the net cost of refining crystals (polarization 98°) for 1916 at 9s. 10d., for 1917 at 8s. 9d., for 1918 at 10s. 3½d., for 1919 at 11s. 6d., and for 1920 at 13s. per cwt. The writer has collected a large number of data concerning the net cost of white Java sugar, and although these are perhaps not quite exhaustive, they may be considered as fairly representative for the whole island.

Net Cost of Java Sugar Cane in 1920.

	Per bouw. Guldeners.	Per acre. £ s. d.	Per picul of Cane. Cents.	Per long ton of Cane. s. d.
Rent of land	65 ..	3 1 9 ..	5·4 ..	1 6
Cultivation	150 ..	7 2 7 ..	12·5 ..	3 5
Cane Tops	80 ..	3 15 3½ ..	6·6 ..	1 9½
Fertilizers	210 ..	9 19 1 ..	17·5 ..	4 9½
Management	10 ..	0 9 6 ..	0·8 ..	0 3
Sundries	15 ..	0 14 3 ..	1·2 ..	0 4
Cost of cane in the field ..	530 ..	£25 2 5½ ..	44·0 ..	12 1
Cutting and transporting ..	.. ..	.. ..	12·1 ..	3 4½
Repairs to cars, etc. .. .	.. ..	.. ..	0·9 ..	0 3
Management.. .. .	.. ..	.. ..	0·7 ..	0 2½
Cost of cane at the mill ..	.. ..	.. ..	57·7 ..	15 11

The tonnage of cane has been calculated at 1200 piculs per bouw or 41·6 tons of 2240 lbs. per acre.

Assuming a rendement of 10 per cent. white sugar from the cane, we then come to the following expenses:—

Net Cost of White Java Sugar in 1920.

	PER PICUL OF SUGAR. Guldeners.	PER TON OF SUGAR £ s. d.
Cane in the field	4·40	5 19 6½
Cutting and transporting of cane..	1·37	1 17 2½
Manufacturing	0·60	0 16 3½
Package	0·50	0 13 7
Transport of sugar	0·45	0 12 2½
Wear and tear	0·35	0 9 6
Repairs.. .. .	0·35	0 9 6
Management	1·10	1 9 10½
Commission on the sales.. .. .	0·05	0 1 2
Sundries	0·10	0 2 8½
Taxes and contributions	1·40	1 18 0½
Total net cost	10·67	£14 9 0

The Cost of Sugar Production in Java.

This net cost includes everything, save interest on capital and renewals, and is calculated for white sugar, ready for direct consumption. The cost of refining crystals will be less per ton, not only because of the smaller costs in making, but also because of the higher yield per 100 parts of cane, which reduces the cost per unit. The difference may be about 75 cents. per picul or 20s. per ton.

The excess profit tax, which is levied on the difference between the selling price and 10 guilders per picul, is not incorporated in this price. It is estimated for 1920 at 5 guilders per picul, thus bringing the total net cost-price in that year, inclusive of all taxes, to 15.67 guilders per picul or £22 1s. 3d. per ton of white sugar.

Retail Prices of Refined Sugar in different Continental Countries on January 1st, 1921.

(From our Continental Correspondent).

Below will be found a list of the prices of refined crystals in force during January in a number of countries of Europe. These prices imply the ones which have to be paid in the shops of the countries concerned. They include all duties and taxes, and all profits of producers and middlemen. We have given the quotations in the monetary value of the respective countries, without making any attempt to convert them to one or other basis, as in these days the rates of exchange are so far out of proportion, that such attempts appear to us to be quite fruitless. We have given as a comparison the quotations of six and of twelve months ago, expressed in the same values for the same quantity as in the present quotations.

COUNTRY.	RATE.	JAN. 1ST, 1920	JUNE 1ST, 1920.	JAN. 1ST, 1921.
Austria	crowns per kg.	15.20	38 0	96.0
Belgium	francs per kg.	1.80	2.0	3.0
Czecho-Slovakia ..	crowns per kg.	2.90	3.26	7.90
Denmark	crowns per kg.	0.58	—	—
Finland	marks per kg.	—	—	17.70
France	francs per kg.	2.10	3.15	3.50
Germany	marks per lb.	2 10	2.0	3.60
Hungary	crowns per kg.	35.0	27 0	125.00
Italy	lires per kg.	6.0	8.50	8.50
Netherlands .. .	guilders per kg.	0.60	0.60	0.80
Norway	crowns per kg.	1.92	1.76	1.89
Poland	marks per lb.	—	—	36.0
Spain	pesetas per kg.	1.50	—	2.90
Sweden	crowns per kg.	—	1.39	—

In most of these countries, sugar is still rationed to a larger or smaller extent. In Belgium, France, the Netherlands, and Spain, sugar may be purchased by the ordinary customer in any quantity which he may desire, but in every country, save France and the Netherlands, the maximum prices are fixed by the Government.

In France and in Holland the price of sugar is quite free from Government interference, so that theoretically it is only subject to the laws of supply and demand. But in these present disturbed days of interrupted traffic and of warfare, certain corporations have secured for themselves practical monopolies, so that they simply dictate the price which the buyer has to pay.

Thus one reads in the *Journal des Fabricants de Sucre* that on March 6th, 1916, the French Government entrusted the firm of Messrs. GRADIS & FILS of Bordeaux with the reception and transportation of all the American granulated and raw cane sugar purchased by the said Government, to the exclusion of every other merchant. The firm was entitled to a remuneration of half a franc per 100 kg., or a very modest sum at that rate. On July 12th of the same year Messrs. GRADIS & FILS obtained also the monopoly of the transport of the sugar from the ports of arrival to its ultimate destination, with the custom house operations and with the collection of the duties, at a surplus remuneration of another quarter of a franc per 100 kg. During 1916, 1917, and 1918 the firm received 983,648 tons of sugar and reshipped 145,135 tons. As these quantities appear to be the ones which the French Government bought through the intermediary of the Royal Commission on Sugar Supply, it is evident the firm of GRADIS & FILS had virtually the monopoly of these operations, a not surprising feature in war time. But it appears that now the war is over the same merchants have maintained themselves in their favourable position, for it appears that the Czecho-Slovakian committee sent to France in order to negotiate sales for 100,000 tons of sugar were invited by prospective buyers to use the intermediary of this Bordeaux firm. In this connexion we read in a report appearing in the *Prager Zuckermarkt* the following surprising particulars anent the operations of the French refiners. We would add that we only quote here our contemporary's remarks without knowing whether the facts are exactly as represented there. "The negotiations for the sale of our sugar were partly rendered fruitless, because the only prospective buyers, i.e., the French refiners, wanted to purchase our beautiful crystals at the same price as the French centrifugals No. 3, and the Cuban raws of 96° polarization, in the latter case only making allowance for the yield to be expected from them, calculated at 92 per cent. The reader will undoubtedly ask why the refiners want to buy sugar which needs no further refining and might be consumed as it is. They can only spoil it by mixing it with French sand sugar or even with colonial sugar, if they do not intend to pack the granulated beet sugar in their own sacks and sell it as refined at the price of that article. Why did we not offer our sugars direct to the consuming public? Because, under the prevailing circumstances, nobody in France wanted to buy foreign sugar so long as the domestic product was on the market in large quantities. The refiners wanted to profit by that circumstance to supply themselves with any foreign sugar that offered, in order to sell it later on to the public through their own channels. We shall therefore have to offer our beautiful crystals direct to the consuming public without allowing it to pass through the hands of the refiners."

In Holland one powerful body controls almost the entire home raw production and the whole of the refining capacity, and thereby enjoys practically the monopoly of the sale of white sugar in the country. The quotations of the Central Sugar Company regulate the selling price of white sugar in the Netherlands, the only competitive factor being the imported white plantation sugar from Java which is available in restricted quantity and may be used for industrial purposes.

It appears from these facts, that even in countries where Government interference with the distribution of sugar has ended, a kind of private monopoly, developed during the years of official distribution, has taken its place, so that even now no real free trade has returned and the price of sugar is, in such instances, no more subject to economic laws than in countries where the Government still dictates the price to be paid for sugar.

The Sugar Industry in Mauritius.

Report of the Department of Agriculture for 1919.

The annual Report of Dr. H. A. TEMPANY, Director of Agriculture, on the work of the Mauritius Department of Agriculture for the year 1919, contains the following particulars on the sugar industry of this colony during the year in question. It should be observed that they were written in March, 1920, though only now available for publication.

Production.

The effect of the weather conditions during 1919 is seen in the magnitude of the sugar crop, the final estimate of which is 235,490 tons. In Moka, Plaines Wilhems, Savanne and the upper parts of Flacq and Grand Port the returns have on the whole been satisfactory and somewhat above the average; in Pamplemousses, Rivière du Rempart and the lower parts of Flacq the returns, while fair, are considerably below those of the previous year. The occurrence of a cyclone which passed 150 kilometres from Mauritius on March 1st unfavourably affected the sugar crop in certain localities, while the damage done was further enhanced by the rather unfavourable weather conditions which occurred in April, May and June followed by the abnormally heavy rains and high temperatures recorded in August. The result was particularly seen in the low saccharine richness of the canes harvested and in the low extraction of sugar which followed in consequence.

The following figures give the final estimate of the 1919-20 crop compared with the total output of the seven preceding years.

1919-20 SUGAR CROP—FINAL ESTIMATES—IN 1000 TONS (METRIC).

Districts	Estimate 1919	1918	1917	1916	1915	1914	1913	1912
Pamplemousses	24.19	64.22..	49.4..	45.92 {	17.94..	30.83..	27.56..	23.05
Rivière du Rempart	29.26				21.60..	35.23..	30.35..	23.71
Flacq	37.28..	43.69..	39.7..	35.04..	37.93..	43.73..	43.66..	36.11
Moka	35.00..	34.70..	31.7..	31.38..	34.91..	42.09..	37.12..	31.16
Plaines Wilhems	19.61..	19.34..	17.9..	15.74..	13.45..	21.16..	18.04..	13.61
Black River	6.55..	6.25..	6.5..	6.08..	5.13..	6.60..	4.48..	5.19
Savanne	43.57..	40.81..	38.5..	36.19..	40.65..	46.71..	41.38..	39.49
Grand Port	43.03..	43.76..	42.3..	38.62..	42.91..	51.01..	47.11..	40.74
	235.49..	252.77..	226.0..	208.97..	214.52..	227.36..	249.70..	213.06

Of the total production of sugar 94.45 per cent., it is estimated, will consist of *vesou* sugar, the remainder will comprise approximately 1 per cent. first syrups and 4 per cent. low syrups. The improvements which have been adopted in the manufacture of sugar during the past 10 years are strikingly seen when the proportion of *vesou* to the total crop is recorded. These are given below.

Year	Percentage <i>Vesou</i> to Total Crop	Year	Percentage <i>Vesou</i> to Total Crop
1911..	73.80	1916..	80.23
1912..	78.70	1917..	89.85
1913..	80.06	1918..	94.50
1914..	82.01	1919..	94.45
1915..	82.60		

This steady increase shown in the production of high grade white sugar is principally due to improvements in methods of curing, comprising the introduction of Weston centrifugals and the very great extension in the number of malaxeurs in sugar factories.

During the year 54 factories operated; there has been no alteration in the number at work since the year 1918. The average extraction for the crop is estimated to be 10·56 per cent.; for comparison the following data are given for the recovery of the commercial sugar per cent. cane from the year 1914 to the year 1919:—

Year	Commercial sugar extracted per cent. cane	Year	Commercial sugar extracted per cent. cane
1914	10·76	1917	10·62
1916	10·83	1918	10·95
1916	10·30	1919	10·56

The low extraction experienced for the year under review is to be attributed to the poor sucrose content of the canes handled, which averaged 31·16 per cent. The corresponding figures for this and the five preceding years are given below for comparison.

Year	Sucrose per cent. cane	Year	Sucrose per cent. cane
1914	13·57	1917	13·40
1916	13·86	1918	13·63
1916	13·03	1919	13·16

The work of taking off the crop proceeded normally, and all usines had finished the operation of grinding by the end of December. It may be recorded that the number of accidents which occurred in usines during the year was distinctly above the average, while in some districts, notably in the north of the island, factory operations were to some extent hampered by the shortage of water.

At the end of 1918 the total area under sugar cane cultivation was estimated to be 168,670 arpents,¹ an increase of 304 arpents over the similar figure at the commencement of the preceding year. Estate cultivation represented 54·9 per cent. of the total cultivated area, the total area under cultivation by Indian proprietors amounted to 73,725 arpents or 43·7 per cent. The increase on the area cultivated by Indians during the year 1918 amounted only to 92 acres, the smallest recorded for many years.

During 1919, the high prices of sugar which have prevailed have caused a considerable additional area to be put under cane by Indian cultivators, though exact figures in this respect are not yet available. The effect has further been seen in the increased shortages of labour which have been felt in all quarters, and by a very marked increase in the rates of wages paid.

Factory Equipment.

The improvements which have been effected in the equipment of sugar-houses during the year were limited owing to the fact that conditions had not yet become sufficiently normal to enable importations of machinery from abroad to be made on any scale. Orders have, however, been placed for considerable quantities of machinery for delivery in time for the coming crop. A certain quantity of locally made machinery was installed during the year. In this connexion attention may be called to the achievements of local firms in relation to the manufacture of machinery of this description; such things as mills, triple and quadruple effects, vacuum pans, sulphuring apparatus and malaxeurs being regularly manufactured and installed in the Colony. The quantity of sugar machinery thus manufactured by Mauritius engineering firms between the years 1914 and 1919 is given in the following table:—

¹ 1 Arpent = 1·04 acres.

The Sugar Industry in Mauritius.

Summary of Sugar Machinery forged and manufactured in the Colony during the period 1914-1920.

Cane Carriers	1	Juice strainers	6
Crushers	2	Triple Effects	1
Mills	4	Quadruple Effects	5
Hydraulic attachment for Mills....	4	Vacuum Pans	19
Sulphitation apparatus	4	Barometric Condensers	3
Defecators	4	Air Pumps	18
Filter presses	8	Juice and Magma pumps.. .. .	11
Juice heaters	14	Fans	2

A small amount of this machinery was manufactured for export to Réunion and other places, but the majority was installed in factories in the Colony. The estimated total value of the machinery is Rs. 3,600,000. [£240,000 at pre-war equivalent of 1 rupee = 1s. 4d.].

Implemental Tillage.

There are again no improvements of importance to record in relation to agricultural operations, although on certain estates small extensions in the use of ploughs and cultivators have been recorded. The shortage of labour which is making itself seriously felt, however, must in the end tend to the replacement of manual labour by implemental tillage if the sugar industry is to be maintained on the existing scale. The question of the introduction of tractors has continued to be the subject of discussion, but no steps have yet been taken to bring about the introduction of machines for trials. It is anticipated, however, that some practical steps in this direction may be taken during 1920.

Pests and Diseases.

Pests and diseases of sugar cane have been in evidence to about the same degree as in the previous year. The campaign against *Phytalus Smithi* has been vigorously prosecuted, contributions thereto being made by both Government and planters. Towards the end of the year the Chamber of Agriculture recommended that, in order to provide funds for more extensive operations against this pest, a special export tax of two cents of a rupee per 100 kilos of sugar should be levied on all sugars leaving the Colony. Effect was given to this recommendation in Ordinance No. 2 of 1920. The parasitic wasp *Tiphia parallela* imported for the purpose of controlling this pest has now firmly established itself in many parts of the infected zone; its effects are becoming very marked in many places. By the end of the year it had become evident that a very perceptible reduction in the incidence of the pest was taking place, and there appears reason for hoping that in a few years time the danger to be apprehended from this insect will have become very much mitigated if not entirely dispelled. Peripheral patrol collection of insects has been maintained during the year with the object of limiting outward spread of the pest. Root disease of sugar cane was again in evidence in certain localities, although no particular increase in the incidence of the disease has to be recorded. Other fungoid diseases have not been markedly in evidence.

Marketing the Sugar.

The market prices for sugar have ruled at very high values during the year under review. As the result of the successful operations of the scheme organized for the disposal of the 1918-19 crop, whereby the sale of sugars was arranged on a co-operative basis with the assistance of an advisory committee, a Syndicate of Sugar Planters was formed during the year 1919, for the purpose of arranging

sales of sugar in a similar fashion to that adopted in the case of the former year, the formation, privileges and rights of the Syndicate being provided for by a special Ordinance (No. 10 of 1919) passed by the Council of Government. The majority of the estates in the Colony adhered to the Syndicate in question; in August, 1919, as a result of negotiations conducted by Messrs. Blyth Bros. & Co., the Royal Commission on the Sugar Supply notified to the Mauritius Syndicate their acceptance of 175,000 tons of *veson* sugar, at 51s., 50s. and 49s. f.o.b. per cwt. respectively. Since that date sugar prices have undergone a further upward trend, while the operation of the exchange has caused the transaction to be somewhat less favourable than was at first anticipated. Notwithstanding this, however, prices realized have been considerably in excess of any that have been witnessed for many years. The effect of the sugar market conditions has further been seen in the high prices which have prevailed for planters' canes purchased by factories, the average prices for which have ranged between Rs. 30 and Rs. 35 per ton. [Say 40s. to 45s.].

Experimental Work—Manures and Seedlings.

Experimental investigations concerning certain phases of the sugar industry have been continued during the year by the Department of Agriculture. The principal investigations have comprised the continuation of trials with manures and with varieties of canes. The results of the series of manurial experiments conducted between the years 1913 to 1918 have been published in the form of a Bulletin. The trials have comprised numerous repetitions of experiments with different combinations of manures on plots 1/20th of an acre in area situated in the fields of sugar estates in the Colony; the plan adopted in laying out these experiments being in accordance with standard agricultural practice in experimental work all over the world. The results have shown that applications of sulphate of ammonia and nitrate of soda to canes which have received dressings of *fumier* may produce substantial increases in yield, but that these increases are dependent on the absence of other limiting factors, while their remunerative character is a question of the relative value of manures and canes. The effects of potash and phosphates are more variable.

The question of the production of new varieties of cane has continued to attract attention. At present the industry is largely dependent on a small number of standard varieties, and notwithstanding the very large number of seedling canes both of local and exotic origin which have been raised and imported for distribution, few of these have obtained any marked degree of popularity on estates. It is believed that this has been in part due to the absence of provision for the systematic trial of selected varieties under varying conditions, and to remedy this defect a large and comprehensive system of trials has been worked out and established during the past three years. This system now comprises the raising of seedlings; their selection and trial on one-hole plots in the field; the further selection of these and trial of the best on six-hole plots; re-selection and trial of the most promising on 30-hole plots at Réduit and Pamplémousses, and final re-selection and trial on co-operative 60-hole plots situated on estates throughout the Colony. This is combined with the importation and trial of promising seedlings from other parts of the world. The reaping of the first season's trials on these lines was completed during 1919, and the results are now available. Among the newer canes which stand out as likely to give satisfactory results may be cited the following:—D. 109, R.P. 6, 291^{os}, B. 3390, B. 6308, 55/453, 64/14, R.P. 8, 15^{oc}, 33/95, 55/452, B. 6450, 131/126, R.P. 73, P.O.J. 213, D.K. 74, 33/187, 33/231, 103/06. These canes are recommended to planters as worthy of careful trial.

The Sugar Industry in Mauritius.

Irrigation.

During the year the irrigation of canes from the reservoir at La Ferme was continued on approximately 2000 arpents; it is anticipated that during 1920 the scheme will be completed and the irrigated area considerably extended. The returns from the irrigated area were subjected to an analysis by the Director of Agriculture during the year, from which it appeared that for the year 1918 the average returns of canes per acre from the irrigated area amounted to 22·8 tons for an average water expenditure of 284,000 cub. ft. per acre. This return is considerably below expectation and compares unfavourably with similar returns for irrigated canes in other parts of the world. The actual returns themselves fluctuate very greatly and little or no co-relation can be established between the water expenditure and the cane returns; there seems little doubt that in certain cases the low returns experienced are the outcome of hurried work done from a desire to get the land under cultivation with the least possible delay in view of the favourable condition of the sugar market, combined with lack of experience in this particular form of cultivation. In some instances very good results were recorded and there seems no reason to doubt that with careful work and greater experience the average returns are capable of being very greatly augmented. Proposals for the establishment of an experiment station for the investigation of problems connected with the irrigation of sugar cane were put forward during the year and are now under consideration.

The Production of Alcohol.

Owing to the very high prices which have prevailed for sugar and cane, interest in agricultural industries other than the production of sugar has been restricted during the year, the lack of interest having been accentuated further by the adverse operation of the exchange. It is to be regretted that this should be the case since the introduction into the colony of the large amount of surplus capital consequent on the favourable market conditions for sugar offers special facilities for the development of subsidiary industries. If subsidiary industries could be introduced on an adequate scale, the economic stability of the colony would be very considerably enhanced.

The production of alcohol from waste molasses forms a not unimportant subsidiary industry. At present there are three distilleries operating in the colony; formerly the number was much more numerous. The industry is capable of considerable extension while the methods of production could be considerably improved. The total production of alcohol for the past five years according to the Treasury returns is as follows:—

1918-19	1,529,315 litres	1915-16	1,410,174 litres
1917-18	1,602,414 ..	1914-15	1,091,485 ..
1916-17.... ..	1,883,607 ..		

A certain proportion of this is exported, principally to the Seychelles and Rodrigues; a further amount is denaturated for use for domestic and industrial purposes; the greater part however enters into human consumption locally.

The majority of the molasses produced in the colony is at present used as a fertilizer, being returned to the land. Of late years increasing attention has been devoted to the utilization of alcohol for power purposes. A number of attempts have been made to develop the utilization of alcohol and mixtures of alcohol and ether as a substitute for motor spirit, but for various reasons these have not so far been attended with a very great amount of success. There is however no doubt that there is scope for very large developments in the production of alcohol from waste molasses as a source of power in the colony, while the fertilizing constituents of

the molasses so employed need not be lost, as they are capable of being returned to the land as liquors after distillation. During 1919 the question of alcohol in the colony has been made the subject of investigations by a Commission appointed by the Governor, the scope of the enquiry including both the consumption of alcohol for drinking and its industrial application. The report of the Commission has not yet been issued.

The Queensland Government Central Sugar Mills.¹

THE GENERAL MANAGER'S REPORT FOR 1919-20.

Mr. W. J. SHORT, in the course of his report for the year ending June, 1920, said that the sugar season of 1919 was a repetition of that of 1918, the majority of the mills being compelled to operate on half crops; indeed, so small was the supply in the Gin Gin and Bauple areas that it was deemed advisable to have the cane offering treated at adjacent mills. Whilst the droughty weather throughout Queensland was favourable for harvesting, and added to the sugar content of the cane available, yet the long-continued dry spell disastrously affected the plant cane, so that the 1920 season (the third year in succession) would also show a shortage in production.

There is no doubt that the world is at present facing a great decrease of sugar supply; and this deficit will probably continue for some years, owing to the consumption of sugar for many purposes becoming more general. In all the circumstances, increased milling capacity is required in order to avoid what otherwise will become an ever-widening gap between Australian production and consumption.

Consideration of further additions to the milling capacity of Queensland must also take in the important factor of the trebled cost of machinery in sympathy with world's market prices, and at the same time the lower comparative value of the product. It is very evident that no large mill with tramlines, etc., will be erected in tropical Queensland in future at a lesser cost than South Johnstone—which has heretofore been regarded as over-capitalized—so that, if the venture is to be regarded as a business enterprise, some recognition of the benefits to the State and to land values must be used as a set-off against the increased cost, especially if the mill is to pay a price for cane similar to that of mills built under pre-war conditions.

The sugar output for the season under review was taken over by the Commonwealth under conditions similar to the previous year at £21 per ton of 94 per cent. n.t. sugar.

In March last a conference was convened by the Queensland State Government, which was representative of sugar producers, and which subsequently sent delegates to Sydney, where a new agreement was entered into, covering a period of three years. This is a big step towards a better understanding between the different interests. The most important feature of the agreement was the fixation of a price for sugar of at least £30 6s. 8d. for three years, this being subject to an annual review, and to an increase in the event of an increase in wages in the sugar industry being brought about by the increased cost of living.

The agreement provides for the withholding of 10,000 tons out of the three years' purchase for experiments in white sugar manufacture. White sugar has been manufactured in Queensland previously, and is no new thing. It is very

¹ Sixteenth Annual Report of the Bureau of Central Sugar Mills for the year ended June 30th, 1920. Paper, C. A. 68, 1920; published by ANTHONY JAMES CUMMING, Government Printer, Brisbane, Queensland. Price: 9d.

The Queensland Government Central Sugar Mills.

evident that, with the present shipping difficulties and fixed prices, it would at present be advantageous for mills to make mill whites for local consumption. However, this is a matter which affects the Commonwealth pool, and so the mills are necessarily confined to experiments with a view to the discovery of a method of producing permanent white sugar, capable of storage, as distinct from a

TABLE No. 1.

Cost of Manufacture, Season 1919-20.¹

ITEM.	BABINDA.		SOUTH JOHNSTONE.		PROSERPINE.	
<i>Particulars of Manufacture—</i>						
Number of suppliers ..	158	..	183	..	238	
Tons of cane crushed ..	140,216	..	86,554	..	35,260	
Tons of sugar manufactured at 94 n.t. ..	16,367	..	10,744	..	4,851·7	
Average cane per ton of sugar	9·13	..	8·06	..	7·27	
Average cost of fuel per ton of sugar	5s. 3d.	..	3s. 6d.	..	6s. 7d.	
Average cost of cane at weighbridge	£1 12s. 9d.	..	£1 15s. 11d.	..	£1 18s. 6d.	
Average cost of cane per ton of sugar	£14 19s. 4d.	..	£14 9s. 1d.	..	£14 0s. 1d.	
<hr/>						
	AMOUNT.	AVERAGE PER TON CANE.	AMOUNT.	AVERAGE PER TON CANE.	AMOUNT.	AVERAGE PER TON CANE.
<i>Cost of Production—</i>	£	£ s. d.	£	£ s. d.	£	£ s. d.
Salaries, wages, and rations during crushing	22,581.. 0 3 3		14,377.. 0 3 4		8,988.. 0 5 1	
Mill and laboratory supplies	2,316.. 0 0 4		1,452.. 0 0 4		837.. 0 0 6	
Fuel	4,043.. 0 0 7		1,875.. 0 0 5		1,600.. 0 0 11	
	28,940.. 0 4 2		17,704.. 0 4 1		11,425.. 0 6 6	
Cane haulage, railage, etc.	8,867.. 0 1 3		7,831.. 0 1 10		2,506.. 0 1 5	
	37,807.. 0 5 5		25,535.. 0 5 11		13,931.. 0 7 11	
Sugar charges, railage, etc.	11,021.. 0 1 7		4,929.. 0 1 1		3,573.. 0 2 0	
Expenses, off season and general working	8,438.. 0 1 2		8,607.. 0 2 0		5,864.. 0 3 4	
	57,266.. 0 8 2		39,071.. 0 9 0		23,368.. 0 13 3	
Maintenance and repairs ..	10,978.. 0 1 7		13,688.. 0 3 2		8,198.. 0 4 8	
Interest on loans	14,291.. 0 2 1		18,614.. 0 4 4		2,571.. 0 1 6	
Depreciation	13,000.. 0 1 10		12,800.. 0 2 11		1,071.. 0 0 7	
	95,535.. 0 13 8		84,173.. 0 19 5		35,208.. 1 0 0	
Cane purchased	220,967.. 1 11 6		147,440.. 1 14 1		65,439.. 1 17 1	
Total cost	316,502.. 2 6 2		231,613.. 2 13 6		100,647.. 2 17 1	
Revenue	329,002.. 2 6 11		231,613.. 2 13 6		102,812.. 2 18 4	
Profit per ton cane	*12,500..*0 1 9		— .. —		2,165.. 0 1 3	
Cost per ton sugar	316,502..20 12 2		231,613..21 11 2		100,647..20 14 11	
Revenue	329,002..21 8 6		231,613..21 11 2		102,812..21 3 10	
Profit per ton sugar	*12,500..*0 16 4		— .. —		2,165.. 0 8 11	

^{*} Transferred to Redemption Reserve as per Award.

¹ Considerations of space preclude us from giving in this Table the figures of the North Eton mill; but it may be observed that the operations of this mill resulted in a loss of £3884, or 2½s. 1d. per ton of sugar turned out.—[Ed. J.S.J.]

bleached white sugar. Experiments are being carried on at Babinda with this object in view.

In concluding his report, Mr. SHORT adds that, whilst industrially operations this year are proceeding very satisfactorily, it is again apparent that little

TABLE No. 2.

Chemical Control Results, Season 1919-20.

ITEM.	BABINDA.	SOUTH JOHNSTONE.	PROSER- PINE.	NORTH ETON.
Cane crushed per week, tons	4,623 ..	4,350 ..	2,820 ..	1,890
Crushing rate per hour, tons	37.3 ..	35.5 ..	25.7 ..	17.7
Fibre in cane, per cent.	11.47 ..	11.6 ..	11.27 ..	12.6
Sucrose in cane, per cent.	13.47 ..	14.67 ..	16.23 ..	15.81
C.C.S. in cane, per cent.	12.14 ..	13.43 ..	14.90 ..	14.51
E.S.J. per ton cane, gallons	210 ..	200 ..	238 ..	189
Extraction, per 100 sucrose in cane ..	91.2 ..	91.1 ..	92.2 ..	86.8
Effect Supply Juice—				
Brix	14.64 ..	16.42 ..	15.33 ..	17.51
Sucrose	12.34 ..	14.02 ..	13.38 ..	15.15
Purity	84.3 ..	85.4 ..	87.3 ..	86.5
Final Bagasse—				
Sucrose	4.05 ..	4.47 ..	5.09 ..	7.1
Moisture	55.6 ..	54.5 ..	48.3 ..	47.8
Press Cake—				
Sucrose	* ..	* ..	* ..	9.5
Moisture	* ..	* ..	* ..	60.3
Sugar Manufactured—				
No. 1, tons	14,817.2 ..	10,323 ..	3,851 ..	2,470
No. 2, tons	— ..	14 ..	814 ..	317
Other brands, tons	— ..	— ..	153 ..	43
Average n.t. all sugars	97.42 ..	97.70 ..	94.93 ..	93.86
Total sugar made at n.t.	15,357 ..	10,744 ..	4,851.7 ..	2,827.5
Sucrose Balance—				
Recovered in sugars, per cent. ..	77.5 ..	80.6 ..	82.0 ..	76.7
Lost in final bagasse, per cent.	8.8 ..	8.9 ..	7.8 ..	13.2
Lost in press cake, per cent.	* ..	* ..	* ..	0.6
Lost in molasses, per cent.	8.8 ..	8.5 ..	8.5 ..	6.0
Balance, undetermined loss, per cent.	4.9 ..	2.0 ..	1.7 ..	3.5
Sucrose in cane	100.0 ..	100.0 ..	100.0 ..	100.0
Recovery of sucrose entering manufac- ture, per cent.	85.0 ..	88.5 ..	88.9 ..	88.4
Efficiency, per cent., c.c.s.	90.2 ..	92.4 ..	92.3 ..	85.9
Tons, cane per ton 94 n.t.	9.13 ..	8.06 ..	7.27 ..	8.02
Firewood burnt, tons	4,472 ..	2,521 ..	2,533 ..	2,000
Firewood per ton cane	0.032 ..	0.029 ..	0.072 ..	0.088
Firewood per ton sugar	0.298 ..	0.235 ..	0.522 ..	0.707
Area harvested, acres	6,600 ..	5,183 ..	2,375 ..	1,982
Average tonnage per acre	21.2 ..	16.7 ..	14.9 ..	11.44
Number of farmers cutting cane	158 ..	183 ..	238 ..	127
Average crop per farmer	887 ..	473 ..	147 ..	178
Factor of safety	— ..	3.3 ..	3.3 ..	—
Rainfall	118 ..	99 ..	48 ..	No records
Tons c.c.s. in cane	17,022.2 ..	11,624.0 ..	5,263.7 ..	3,290.7

* Thomas & Petree process used.

The Queensland Government Central Sugar Mills.

change over that of the previous year has developed so far as regards crops in cane-growing districts south from the Burdekin. Babinda again has a huge crop, and is crushing steadily. South Johnstone has approximately 100,000 tons available, but Proserpine and North Eton are half crops, whilst Gin Gin and Bauple again have less than 10,000 tons between them. This, indeed, is to be regretted, but as a set-off it has to be stated that the increased price, with the splendid weather which has prevailed during the planting season, points to a very large crop throughout Queensland for the 1921 season.

THE INSPECTING ENGINEER'S REPORT.

Mr. W. HILLHOUSE gives details of improvements and alterations effected to the plant of the Government mills during the period under review. His remarks are mainly of local interest, but it may be noted that he advises, "taking into consideration the very large proportion of Badila cane now being crushed," the installation at Babinda and South Johnstone of a shredder, which would replace the present Krajewski. "It will be admitted that the shredder is much the better preparatory device of the two." In all the mills juice grooves have been cut in the feed rollers, and suitable scrapers provided. At Proserpine six new 42-in. centrifugals have been ordered.

THE SUPERVISING CHEMIST'S REPORT.

Mr. H. C. OAKES reported that owing to the dry weather the quality of the cane was exceptionally high, as one may see by the values given for the c. c. s. in the table summarizing the chemical control results. Extraction was improved at South Johnstone, North Eton, and Proserpine, but Babinda was not quite so good as the previous season. Further, the crushing rate has been increased at all the mills. The Thomas and Petree process is in operation at all the mills, excepting North Eton. At Proserpine where it was in use for the first time (thus cutting out the filter-press station and its concomitant expenses) the extraction was higher than in the previous season by 0.2 per cent., though the quantity of maceration water used was less (236 gall. mixed juice compared with 250 in 1918), while the "efficiency" value was slightly improved also. It had been hoped to improve the conditions prevailing at the centrifugals, where the steam makes the station uncomfortable, but the efforts made in this direction have not been very successful. The only alternative is considered to be the installation of up-to-date bottomless machines, though as a temporary measure fans have been fixed to draw off the steam from the discharged sugar. As may be seen from the control figures, the "efficiency" at the South Johnstone mill has been considerably improved, viz., from 89.7 to 92.5, mainly as the result of better cane.

It is possible now to say something more about the proposal to manufacture phosphoric acid in a pure state by heating together phosphate rock, sand, and coke to a temperature of about 1600-1600°C. in a furnace consuming oil.¹ Successful results are now claimed to have been obtained by W. H. WAAGAMAN and T. B. TURLEY,² in which 97 per cent. of phosphoric acid present in the rock was volatilized, giving a liquid containing about 40 per cent. of H_3PO_4 . This process is stated to be economically superior to the present method of making soluble phosphates for fertilizer purposes. Even after making the most liberal allowances for the various items, the total cost by the furnace method was computed to be \$49.83 per ton, or 2.49 cents per lb.; whereas the cost of making a ton of phosphoric acid in the form of acid phosphate (given by three large firms working under the most favourable conditions) is \$81.25, or 4.6 cents per lb. Considering that a concentrated product suitable for transport overseas is thus obtained, the future of this process is thought to be very promising.

¹ *I.S.J.*, 1916, 509; 1917, 85.

² *Chemical Trade Journal*, 1920, 47, No. 1753, 833-837.

Progress made in Sugar Manufacture and By-product Utilization in Hawaii.

The Committee appointed by the Hawaiian Sugar Planters' Association to report on Manufacturing Machinery consisted of J. N. S. WILLIAMS (who acted as Chairman), S. S. PECK, W. G. HALL, W. A. RAMSAY, A. GARTLEY, E. KOPKE, and GEO. R. EWART, JUNR. The following is a summary of their survey of the subject for the year ending September 30th, 1920.

MEINECKE INTERMEDIATE BAGASSE CHUTE.

A report is presented on an interesting new development in the handling of partly crushed cane as it passes from one mill to the next, which is said to be due to Mr. MEINECKE, chief engineer of the Paia factory of the Maui Agricultural Company. It does away entirely with chains, sprockets, scrapers, slats and other devices heretofore used in connexion with conveyors; and is simply an inclined plane leading upwards from the discharge roller of one mill to a point situated about midway between the two mills being served, and then continuing downwards to the receiving rollers of the following mill. The bagasse issuing from one mill is forced up the incline by the push received from the following bagasse coming forward from that mill, and when the top of the incline is reached the bagasse falls by gravity down the above-mentioned sloping chute into the jaws of the succeeding mill. On its upward course the bagasse is confined by a cover which is placed over the upward incline, the function of which is to prevent the bagasse from piling up in heaps and falling back. Maceration water is applied at the top of the incline, and the water together with the bagasse coming forward falls down the chute into the succeeding mill by gravity as above stated. There are no moving parts to get out of order, and the installation is not expensive. It is easy to clean and cannot get out of order.

Mr. H. A. BALDWIN, Manager of the Paia factory, wrote stating that the Meinecke chutes were in successful operation in lieu of intermediate carriers between the mills. They proved so satisfactory as to have been installed to the entire exclusion of power conveyors between the units of the 21-roller mill. They are regarded as "the more important development in mill equipment since the introduction of the Messchaert groove." Meinecke chutes eliminate all moving parts; obviate delay due to breakage of chains; and avoid expense for repairs and upkeep. Compared with mechanically operated conveyors, they require less power besides being cleaner. By the removal of half a dozen bolts, the chute may be opened up, which operation requires less than five minutes. Moreover, there is abundant head-room under the chute, allowing free access to the bottom rollers at both ends.

SCREENING RAW JUICE AFTER IT LEAVES THE MILL.

Mr. J. O. FRAZIER recently emphasized the importance of mechanically screening the juice "to rid it of the millions of particles of cane fibre dislodged in the milling. . . . Much of this finer trash mixed with dirt from the cane will be 'loaded' until it is almost of the same specific gravity as the cane juice. This change of weight will prevent its rising to the surface for skimming and equally prevent prompt settling. . . . The tendency is towards the use of screens of too coarse mesh, which are constantly exposed to the wear and breakage of the paddles of the trash elevators. . . . A favouring circumstance toward better juice screening is the use of finer mesh screens than the average used. Centrifugal sieves, for instance, with 625 holes to the sq. in., come nearest to the

Progress in Sugar Manufacture and By-Product Utilization in Hawaii.

cleaning of the cane juice at a single screening. When screen of this mesh does not screen freely, it is due to the too slow speed of the trash elevator, or the improper fitting of the flights or paddles over the surface of the screen, or possibly to an insufficient screening surface. . . ."

In the Report¹ of the Committee on Manufacturing Machinery issued by the H. S. P. A. in 1916 it was said that: "One of the pieces of apparatus in a sugar mill which is a source of continual breakage and trouble is the juice strainer, which usually consists of a screen varying in length from 6 to 10 ft., and in width from 12 to 18 in., over which slats are dragged by means of a single or double chain. . . . The slats wear easily, the chains become foul with gummy matter, and the inversion of the juice taking place on the chain links not only causes a disagreeable smell but also in time corrodes the metal to such an extent that frequent renewals are necessary. . . ."

Mr. S. S. PECK now points out that in the present system the use of perforated screens is imperative in order that the scrapers should function properly. While a fine mesh screen is desirable, it has a serious objection in that when the openings are small, a thin metal is of necessity used, and the wear and tear is accentuated. The usual sized screens are the No. 1 and No. 3; the actual straining area in these screens, and also of centrifugal 00 screens being as follows:—

Mesh.		Diameter of the Holes		Area of the Openings per Sq. Ft. of Screen
625	.....	0·020 in.	.....	28·27 sq. in.
400	.....	0·027 "	.....	32·98 " "
225	.....	0·029 "	.....	38·70 " "

Woven wire screen presents a much greater amount of straining area in proportion to the size of opening. In the different mesh screens, this varies according to the size or gauge of wire. In comparing the equivalent sizes of openings, while it is true that a square opening say 0·02 in. wide has a wider diagonal opening than a circular one of the same diameter, the extra amount of crush-cush that would pass this space is negligible. As a comparison, the following table will illustrate the advantage of the woven screen:—

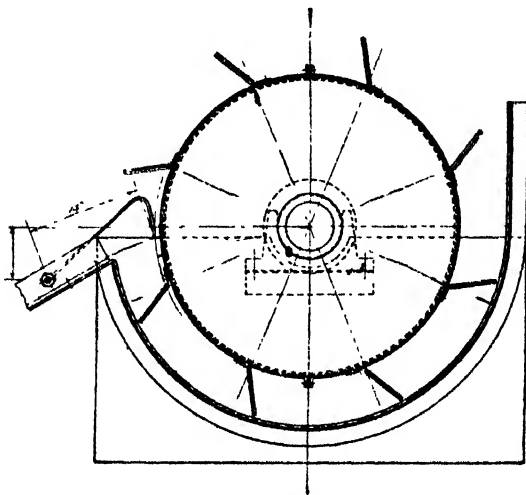
Screen	Number of openings per sq. in.	Size of opening in.	Gauge of the wire	Sq. ins. opening per sq. ft.	Per cent. excess over per- forated
Perforated ..	625	.... 0·020	.... —	28·27 —
Wire	784	.... 0·0197	.... 28	43·80	.... 54·9
Wire	1225	.... 0·0196	.... 36	67·77	.... 139·5
Perforated ..	400	.... 0·027	.... —	32·98 —
Wire	576	.... 0·0267	.... 29	59·13	.... 73·2
Wire	784	.... 0·0267	.... 38	80·48	.... 144·0
Perforated ..	225	.... 0·039	.... —	38·70 —
Wire	256	.... 0·0375	.... 23	51·84	.... 34·0
Wire	400	.... 0·039	.... 33	87·61	.... 126·4

This would indicate that, providing the mechanical appliances could be devised, a decidedly larger straining area could be secured with approximately the same sized openings by the use of woven wire screens instead of perforated metal.

In the accompanying sketch is shown a revolving strainer devised by Mr. PECK. It differs from most revolving strainers in that the juice is passed from without through the screen, and removed by suction. The strainer revolves

¹ I.S.J., 1917, 71,

in a bath of the juice, and the *cush-cush* remains in the containing trough, being removed by scrapers attached to the cylinder, and kept clean by a pulling scraper operating automatically. Since there is no pressure or rubbing on the screen surface, the particles are not forced into the openings, but are lightly deposited thereon. As the screen emerges from the bath, there is a thin covering of the lighter particles which are in part removed by the juice from the juice supply trough and in part by floating off as the strainer revolves in the liquid. A small



JUICE STRAINER.

steam pipe passes through the juice pipe, and in case stoppage in the screen does occur it may be cleansed by a jet of steam in the direction opposite to the flow of the juice. This will also have a beneficial sterilizing effect on the screen surface. A further advantage is that in using this form of screen a very fine mesh can be utilized, or a larger mesh with finer wire. The advantage of such a condition is plainly shown in the table on straining area already presented.

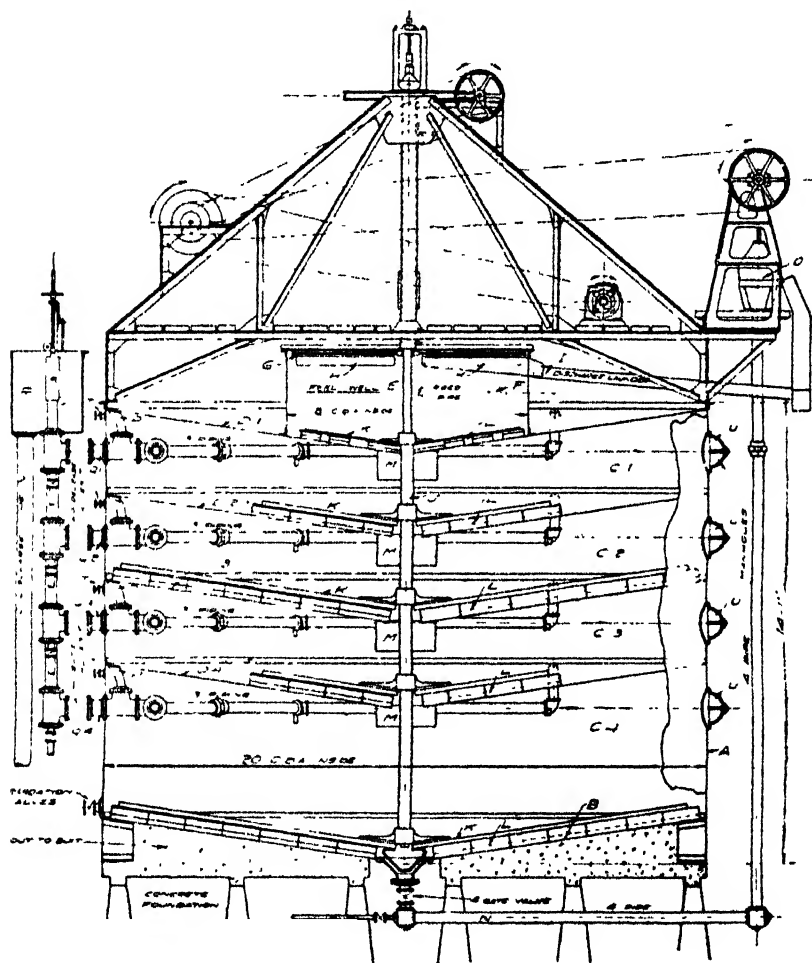
CENTRIFUGAL CLARIFICATION.

RESINES, who recently patented a centrifugal machine for the clarification of cane juice, is confident that good results could be obtained by the centrifugal sedimentation of the raw juice. He states that by liming the juice as it comes from the mills, and centrifuging, it will come out of the machine free from suspended matter, from *bagacillo*, and from organic lime salts. He found further that by sedimentation of the cold juice in this way, about 85 per cent. of the usual amount of scums could be obtained, that is to say that the scums obtained by heating the juice after it had been treated in the cold by centrifugal sedimentation amounted to less than 15 per cent. of the whole. Again, it was found that by liming the cold juice in excess, treating it in the centrifugal machine, sulphiting until neutral, heating it to coagulate the albuminoids, and again centrifuging, the result was a very bright and brilliant juice having only a faint colour. A practically white sugar could be produced from it; while the molasses was of very low viscosity. Mr. PECK concludes his contribution by saying that these observations indicate the possible advantages of centrifugal sedimentation, and also emphasize the importance of the successful removal of the *cush-cush*.

DORR CLARIFICATION APPARATUS.

Experiments have been carried out with the Dorr clarification apparatus in Cuba.¹ Very promising results have been obtained, and there is apparently no reason why these should not also be obtained under Hawaiian conditions.

In the illustration is shown a Dorr clarifier capable of dealing with the juice from 2000 tons of cane per day. It consists of a circular tank *A*, 20 ft. diam. \times 14 ft. high, having a conical bottom *B*, firmly embedded in concrete; and is divided by plates *D* into four compartments C-1, C-2, C-3, and C-4. The slope of the cone towards the centre is the same as that of the bottom. On the upper



DORR CLARIFIER.

division plate *D* rests the feed well *E* about 8 ft. diam. \times 2 ft. 6 in. deep. The feed well *E* is provided with a juice inlet pipe *F* with revolving skimming paddle *G* and a discharge outlet *H* to a launder *I* for conveying skimmings. In the centre

¹ I.S.J., 1920, 584, 650. Its main advantage seems to be that it gives a mud of greater density than is obtained by simple settling, so that less filter-press area is required.

of the tank is placed a vertical shaft *J* revolving once in six minutes, on which are fastened arms *K* carrying scrapers *L* that touch the conical plates *D*. The feed well *E* has a central tube *M* reaching into the compartment below it. Through this tube juice and mud flow to the next compartment below it and in a like way from subsequent compartments to the next below. The centre of the tank bottom is connected to a 4 in. pipe *N* which conducts by the suction of a pump *O* the mud to the mud presses. The clear juice is drawn from each compartment at three equally spaced points *P* at the highest part of the compartment near the periphery of the tank. The clear juice pipes *Q* from each of the compartments are connected separately outside of the tank to an overflow box *R*; the top edge of this box is level with the feed well overflow. The height of overflow can be regulated separately by screw and handwheel operated sleeves *S* and the rate of flow increased or decreased by this adjustment. Air vents *T* and manholes *U* with covers are provided.

In operating the Dorr clarifier, juice from the heaters enters the feed well *E*, and fills the whole tank up to the line of overflow in the well. The central vertical shaft *J* with the arms *K* and scrapers *L* is set in motion by an electric motor and through proper reduction gear, as the result of which the light scum on the juice in the feed well *E* is brushed into the launder *I* by the skimming paddles *G* and flows to the mud presses. Heavy impurities drop on the conical plates *D*, but are induced to move towards the central tubes *M* by the slowly moving scrapers *L*, and pass on in a more or less direct way until the mud discharge pipe *N* at the very bottom is reached. The clear juice is induced to flow into overflow box *R* at a desired rate by lowering the slideable sleeves *S* over the discharge pipe to the required height. The box *R* serves the purpose of providing the means of regulating the rate of flow. From box *R* the juice is led to the evaporators through pipe *V*. The points of advantage of this design seem to be: (1) small floor space; (2) large cross section; (3) shallow depth of juice; and (4) the continuity of the process.

UTILIZATION OF MOLASSES FOR MOTOR SPIRIT.

At the Paia factory of the Maui Agricultural Co. a plant for the production of alcohol motor spirit ("Natalite") from so-called final molasses has been in use for some time.

It has a capacity of 500 galls. per day, and the fuel is produced ready for use in automobiles, tractors, or internal combustion engines at a small cost when the initial cost of molasses is not taken into consideration. Moreover, the potash, nitrogen, and phosphoric acid may be recovered at small expense, and the value of the fertilizer so obtained is estimated to be very nearly equal to that of the motor spirit manufactured. It is said that the value of this motor spirit is fully equal to gasoline as fuel to be used in internal combustion engines, but that some difficulty has been experienced by reason of the nozzle in the carburettor wearing larger during operation, thus causing an excessive use of the fuel. This difficulty has been overcome by making the nozzle of a suitable non-corrosive material.

Prof. J. J. WILLAMAN,¹ of the University of Minnesota, U.S.A., advocates the use of levulose syrup (produced by the hydrolysis of the inulin present in the Jerusalem artichoke) for blending with other syrups (starch glucose and maltose) to enhance their sweetness. He considers that levulose might very largely replace sucrose in the manufacture of "soft drinks" and confectionery. A yield of about 4000 lbs. (1.78 long tons) per acre could be obtained, and the hydrolysis of the inulin to levulose should present no difficulty on the industrial scale.

¹ Science, 1920, 52, No. 1346, 351-352.

The Entrainment of Juice during Evaporation and Boiling as the Cause of High "Unknown Losses" of Sugar.

As an explanation of the high unknown losses of sugar during the evaporation of juice in the multiple effect of a certain sugar factory in Java, A. SCHWEIZER¹ has suggested that decomposition of the entrained juice occurs, owing to its "atonization" as the result of the rush of steam through the vapour line. This view was supported by Messrs. VAN HAM and OLSEN,² but quite a different aspect is now given to the matter by Mr. J. S. DE HAAN.³ His experiments and conclusions are of great interest to sugar factory chemists.

Speaking always of the conditions prevailing in Java, he believes that higher losses generally occur owing to entrainment than are suspected; and that the extent of these losses cannot be determined by the examination of the condenser water, as is ordinarily done. He was led to this conclusion by the examination of the waste waters when he knew positively that a good deal of entrainment was occurring. Almost invariably only a small loss was indicated, and sometimes none at all; and the reason of this was believed to be due to the fact that the spray entering the Torricellian condenser does not mix at all thoroughly with the water, there being insufficient agitation and insufficient time to cause the solution of the dense drops of syrup in the liquid. This point was put to proof in the laboratory, using a glass tube 1 metre long and 5 cm. wide, which was provided near the bottom with a small sampling tube, so as to imitate the conditions prevailing in practice as closely as possible, while water and molasses were run in at the top. It was concluded that, even when a comparatively large sample was continuously taken at the bottom of the column, the analytical results showed *only a few per cent.* of the sugar actually entering at the top with the condensed water. In fact in the case of molasses at 85° Brix, the drops reached the bottom practically unchanged. Of course, it may happen now and again that some of these drops reach the neighbourhood of the sampling tube; but they must generally escape detection owing to their very small proportion compared with the large amount of water running through the pipe.

It is believed by Mr. DE HAAN that a reliable indication of the occurrence of entrainment can be obtained by the procedure mentioned by FRIES,⁴ namely, placing small pipes in the vapour line of the effects and condensing the steam aspirated from the apparatus, although it is difficult to see how FRIES obtained the quantitative results attributed to him. On applying this method, Mr. DE HAAN found in all the factories under his control that entrainment had occurred in the last compartment of the evaporator, and frequently also in the pans, leading to the conclusion that the juice-catchers used (generally of the Hodek type) were quite inefficient. At the same time, he observed that the results were most erratic, and in the case of two juice-catchers of similar design apparently operated under the same conditions, one hardly prevented entrainment at all, while the other checked a good proportion of it. After some investigation, the reason of this was traced to the influence of small leaks usually in the connexions, the air drawn in undoubtedly impeding the efficiency of the "catch-all" apparatus, as was shown by the fact that when these leakages had been carefully stopped the

¹ *I.S.J.*, 1920, 706.

² *Ibid.*, 1920, 707.

³ *Archief voor de Suikerlandustrie in Nederlandch-Indië*, 1920, 28, No. 7, 223-271.

⁴ "Cane Sugar." NOEL DERRA. (Norman Rodger, London.) Page 307.

operation of the formerly faulty Hodek was somewhat improved. At any rate, the final general conclusion obtained on continuing the tests was that horizontal juice-heaters provided with perforated partitions are wholly unsatisfactory for retaining the spray entrained in the vapours of multiple effect evaporators, with which opinion both BOLK¹ and GREINER² are to some extent in agreement.

Subsequently, experiments were made with several other types of apparatus; but the best results were obtained with the model shown in figure 1, which was provided with rotating blades giving the vapour a powerful whirl,³ a principle which is also applied in the "Swartwout" apparatus shown in figure 2, described

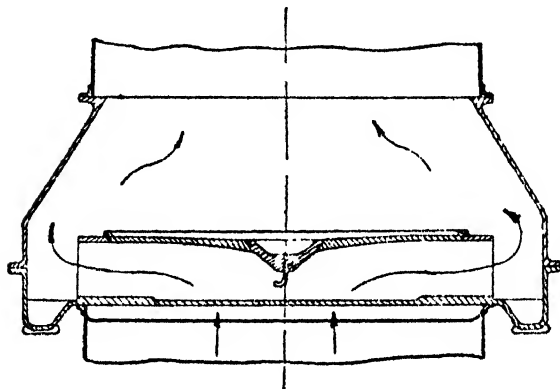


FIG. 1

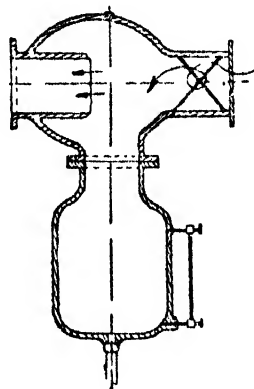


FIG. 2

a few years ago by KERR,⁴ and also in a device used in conjunction with the Kestner film evaporator. Nevertheless, although it was proved that appliances such as these depending upon the action of centrifugal force for the separation of particles of liquid in the steam are much more efficient than any apparatus of the Hodek type, it was found that unless certain well-known rules are observed the model shown in figure 1 does not entirely prevent entrainment. Most of all it must be borne in mind that: (a) the boiling liquid must be kept below a certain height; (b) the capacity of the evaporator must not be forced; and (c) all leakages especially just before the juice-catcher must carefully be stopped.

After working along these lines, and applying the experiment also to the operation of the vacuum pans, a marked diminution in the "unknown losses" was established, as one may see from the following table giving returns from three factories, I, II, and III, in 1918 and 1919, before and after installing the improved appliances and methods. As may be seen, the greatest improvement was

¹ *Archief*, 1909, 622

² "Verdampfen und Verkochen" W. GREINER. (Verlag von Otto Spamer, Leipzig) 1920.

³ It was made by the Constructie Atelier der Vorstenlanden, Java; but no further particulars are given of it in this article

⁴ *J.S.J.*, 1913, 184. It is sold by the Ohio Body and Blower Co., Detroit Avenue, Cleveland, Ohio, U.S.A. A helix or cork-screw device gives the steam entering the separator a whirling motion. Any matter that may be entrained is thrown to the sides of the separator where it collects, and is drawn off. These "helico-centrifugal" separators are also made for separating steam, delivering it 99 per cent. free from moisture without producing any appreciable back pressure. Originally, we believe, the separator was designed as an oil separator between steam engines and surface condensers. In his experiments made in 1913 (*Louisiana Bulletin* 138), Prof. KERR reported very favourably upon the Swartwout separator, stating that it was "very efficient, a slight trace of sugar being shown in the condensed water in only one test." In other tests, even where large quantities of juice were caught in the separator, no trace of sugar was shown by the α -naphthol test. Moreover, he found that the loss of pressure due to the friction of the vapours in passing through the separator was equivalent to 0.5 in. of water with a velocity of 7940 ft. per min., an amount practically negligible. — *Ed.*, *J.S.J.*

The Entrainment of Juice during Evaporation.

shown in the case of factory II, in which the unknown loss was decreased from 3.12 to only 0.78 per cent.

	I		II.		III.	
	1918	1919	1918.	1919.	1918.	1919.
Yield from Winter's formula, $\times 0.96$	102.01 ..	103.16	100.43 ..	103.49	100.81 ..	102.89
Unknown loss, per 100 of sucrose in the cane..	2.45 ..	1.57	3.39 ..	1.17	3.12 ..	0.78
Unknown loss per 100 of cane	0.36 ..	0.22	0.49 ..	0.16	0.46 ..	0.11
Actual yield per 100 in the cane	97.67 ..	98.13	95.87 ..	99.49	96.39 ..	98.61

Finally, a contribution to this discussion on entrainment is made by Mr. J. G. VAN HAM.¹ He remarks, after having read the several papers on the question, that from the technical point of view the Hodek juice-catcher is based on an entirely faulty principle. By interposing such an apparatus in the vapour line, the vacuum is diminished, and the steam pressure is lowered. It belongs to the least useful type of catch-all. In any case, it should not be placed in the vapour pipe, in which, as the result of the great rapidity of the steam, the entrained juice must be forced to form a kind of mist. He believes that the only place for it is in the upper part of the compartment, where it can cause the least obstruction to the vapour, which in that part of the apparatus moves at a comparatively slow speed. Finally, he points out that preference should be given to separators operating on the principle of the Kestner device, which separates the particles by centrifugal force.

Agricultural Implements in Hawaii.

As Chairman of the Committee on Agricultural Machinery and Implements in the Hawaiian Sugar Planters' Association, Mr. F. M. ANDERSON presented to the last annual meeting of that association, held in November, 1920, a short report on progress in the use of agricultural implements in the Hawaiian sugar industry. Little fresh information was forthcoming from the plantations this year, as the record has been pretty thoroughly covered in previous reports. The following is Mr. Anderson's communication:—

Implements for Preparing.

Fowler's Steam Tackle for ploughing and harrowing in dry districts appears to give entire satisfaction. This is undoubtedly due to their ability to stand up to the work with a minimum loss of time for repairs and to loosen the soil the desired depth. Tractors of various makes are also being used extensively, but are not built strong enough by the makers to withstand Hawaiian conditions. The principal makes and uses are as follows:—

Holt	45-60 and 90 H.P. at belt.
Best	60 " 90 H.P. "
Yuba	35 H.P. "
Cleveland	20 H.P. "
Trundaar	35 H.P. "
Monarch	20 H.P. "

Estimating the Power or Speed of a Tractor.

To arrive at horse-power delivered at the drawbar requires a deduction from the above figures of from 30 to 45 per cent., which represents the power required

¹ *Archives*, 1920, 22, No. 14, 481-500.

to propel the tractor. The following extract from a journal of recent date may be interesting :—

"Horse-power of a Tractor.—Two factors go to make up horse-power used by a tractor hitched to a load. One of these is the number of pounds pull and the other is the speed at which the tractor is moving. For instance, at one mile per hour it takes a pull of 375 lbs. on the drawbar to develop 1 H.P., while at five miles per hour a pull of 75 lbs. will do the same. It follows that one cannot measure actual horse-power at the drawbar without using a device that will give the actual pull in lbs."

The reason for the varying pulls in developing the same amount of power at different speeds is seen in the fact that single horse-power is a definite quantity of energy and is equal to 33,000 ft.-lbs. per min. Hence, for a single horse-power, the product of the lbs.' pull on the drawbar by the speed in feet per minute must always remain constant and equal to 33,000 ft.-lbs. per min. If the speed becomes greater, the pull must be proportionately less to give this result.

It simplifies calculations of the amount of horse-power delivered to know that at one mile per hour a tractor is travelling 88 ft. per min., and that for every quarter of a mile added to the speed 22 ft. per min. must be added to 88. A good many tractors work at $2\frac{1}{4}$ miles per hour, or 198 ft. per min. Divide 33,000 by 198 to determine the lbs. of pull required by 1 H.P.. Walk beside the moving tractor, taking steps 3 ft. in length, as nearly as possible. Count the number of steps in 1 min. Multiply this number by three to get the speed in feet per minute. This may be reduced to miles per hour by multiplying by 60 and dividing by 5280, or the table may be used to get the miles per hour. The same table will give the lbs. pull for 1 H.P. at the given speed, or divide 33,000 by the number of feet per minute to get the lbs. pull for 1 H.P.

The step-counting system will give the tractor's speed regardless of whether it is of track or wheel type. With 3 ft. steps, the following tractor speeds in miles per hour may be measured :—

STEPS PER MINUTE.	MILES.	STEPS PER MINUTE	MILES.
44	$1\frac{1}{2}$	73	$2\frac{1}{2}$
51	$1\frac{3}{4}$	80	$2\frac{3}{4}$
58	2	88	3
66	$2\frac{1}{4}$		

The following table for converting speed and the pull into a single horse-power is used by first determining the speed; then dividing the pull on the drawbar by the pull necessary for one horse-power at the speed given :—

MILES PER HOUR.	FEET PER MINUTE.	PULL LBS. PER 1 H.P.	MILES PER HOUR.	FEET PER MINUTE.	PULL LBS. PER 1 H.P.
1	88	375	3	264	125
$1\frac{1}{4}$	110	300	$3\frac{1}{4}$	286	115
$1\frac{1}{2}$	132	250	$3\frac{1}{2}$	308	107
$1\frac{3}{4}$	154	214	$3\frac{3}{4}$	330	100
2	176	187 $\frac{1}{2}$	4	352	93
$2\frac{1}{4}$	198	166	$4\frac{1}{4}$	374	88
$2\frac{1}{2}$	205 $\frac{1}{2}$	161	$4\frac{1}{2}$	396	83
$2\frac{3}{4}$	220	150	$4\frac{3}{4}$	418	79
$2\frac{1}{2}$	242	136	5	440	75

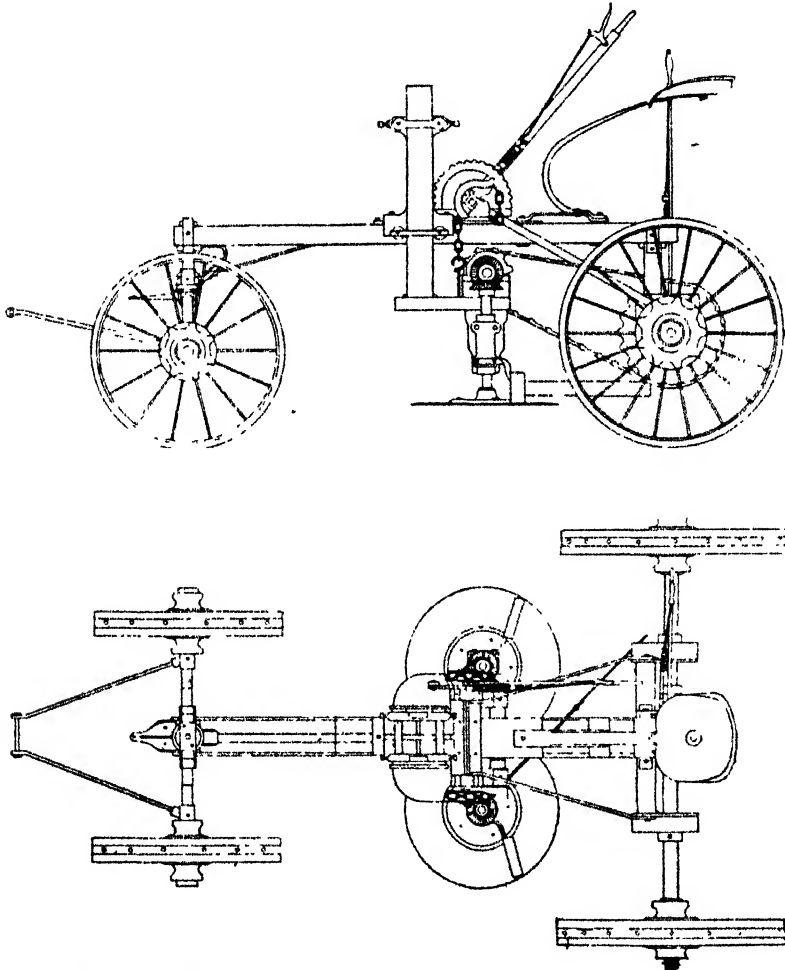
Tractor ploughs, harrows and subsoilers made by the tractor companies and also those put out by the Killefer, Spalding & Deere Manufacturing Companies are now used extensively in Hawaii. The subsoiler put out by the Killefer Manufacturing Company is an implement that should have a great future. These are

Agricultural Implements in Hawaii.

now made with an automatic lift so that the frame and tines are lifted as the machine is pulled forward, which makes it very convenient for cleaning when necessary.

Implements for Cultivating.

The "Silver Stubble Shaver" as shown in side elevation and plan in the figure, is being used with good results at Onomea and Hilo Sugar Company. The shaving discs are easily controlled to the desired depth for the unevenness of the rows by the operator. Three mules can haul it, but a better hitch can be found when hauled by a Cleveland Tractor.



As regards cultivating implements, the "Planet Jr." light cultivator and the Horner cultivator for piling the weeds generally exceed in numbers all other cultivating implements combined. The writer has never considered the "Planet Jr." cultivator a good implement for plant cane, as the middles are higher than the cane line, and due to the formation of the teeth (narrow in front and widening to the rear) there is a decided tendency for this implement to knock the dirt and weeds into the cane line which is the lowest level, and thereby make it heavier

work hoeing, as all that material has to be pulled up to some extent by manual labour.

We find that if the handles, hauling bar, and teeth are reversed, we have a more efficient implement for plant cane, as the arrangement of the teeth (wide in front and narrowing toward the rear) tends to keep the weeds and dirt from falling down into the cane line.

American Commerce Reports.¹

SANTO DOMINGO.

The 1919 sugar season brought great prosperity to all the sugar mills of Santo Domingo, which are located along the south coast of that republic. The crop was of record size, while the average sale price of \$5.75 per cwt. was the highest figure ever recorded in this market. A grand total of 1,166,761 bags of 320 lbs. each, or 166,680 long tons was produced, as compared with 129,294 long tons in 1918. There are 15 mills in the republic, Consuelo with 220,056 bags (31,436 tons) and Central Romana with 140,000 bags (20,000 tons) being the biggest.

INCREASING USE OF TRACTORS IN PERU.

The increasing importance of tractors in Peru may be best realized by comparison of the number imported up until 1919, which was 382, with the number imported during the first four months of 1920, which was 271. At present there are in Peru nearly all types of tractors—European as well as American. There seems to be a marked prejudice, more among dealers than buyers, against tractors of the caterpillar type. However, it is interesting to note that in the northern region of Peru, in the neighbourhood of Paíta, where the soil is sandy, the wheel type tractors have been unable to produce results and a number of small tractors of the caterpillar type are in use and working very successfully.

In Peru, sugar and cotton are not replanted each year, one planting carrying through for several years. The land requires cultivation, however, for while it is fertile it is inclined to harden, and thorough breaking is necessary occasionally. This hardening is inevitable in the case of irrigated lands, such as are all farm lands on the west coast of Peru. Therefore the question of service is a very important one in these irrigated districts. Every farmer usually has a certain fixed amount of water available each year, and the practice is first to irrigate the field before ploughing. If the tractor breaks down just at the time when he has the field irrigated, and he is unable to get the service that will enable him to place his tractor in working condition within a reasonable time, he is in great danger of losing the use of the field for the season. If the land is ploughed while dry, it is likely to break up in large lumps, making it very difficult to prepare the proper seed bed. One reason why tractors are so popular in the irrigated district is that a farmer is enabled to work his land more rapidly than by the use of animal power, thereby conserving moisture, and since the use of water is restricted, he can by this means work more land with the same quantity of water.

In cultivation, the rows are planted 1.3 metres apart, so it will be seen that the tractors to meet this demand should be of the gauge indicated. A tractor, especially a cultivator, that can straddle a row is particularly desirable. Thus one with a bottom clearance of 20 or 24 ins., or more if practicable, could cultivate both sides of a row at once, even after the cane had reached a height of 3 ft. or more. As to the size of tractors most in demand, the small 2 or 3 plough tractor, commonly known as the "12 to 20 H.P." is most in demand, and probably 90 per cent. of all the tractors imported into the country are approximately of this size. [Trade Commissioner's Report, Dec. 1920.]

DEVELOPMENT OF SUGAR INDUSTRY IN NICARAGUA.

The great development in the sugar industry of Nicaragua during the war may be seen from the figures of exports for 1914, 1918, and 1919: The total quantity exported in

¹ Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

American Commerce Reports.

1914 amounted to 1,560,341 lbs.; in 1918 to 13,728,268 lbs.; in 1919 to 8,463,758 lbs. The total production of the country is normally somewhat over 15,000 short tons, the difference between the exports and this quantity being the domestic consumption. Sugar is now fourth in order of value of the exports of Nicaragua, having jumped in the last four years from less than 1 per cent. of the total exports to an average of 6 per cent. The Government encourages the exportation of sugar, placing no tax upon it, and specifying only that not in excess of 60 per cent. of the total production be exported. There is a tax for internal consumption, however, of \$0.50 per 100 lbs., which produces a revenue of \$40,000 to \$50,000 annually, which is devoted entirely to schools. The sugar used for the manufacture of *aguardiente* (native rum) comes under a different system of taxation, being a Government monopoly.

The uses to which the sugar produced is put may be stated to be roughly as follows: 5000 tons for export (plantation white); 4500 tons for domestic consumption; 1500 tons for manufacture of panela (brown sugar used by Indians); 5000 tons for manufacture of *aguardiente*; total, 16,000 short tons.

There are approximately 12,000 acres of sugar land under cultivation, principally in the Departments of León and Chinandega, which acreage is constantly increasing. In these two Departments there are still many thousands of acres suitable for sugar cultivation.

The average production throughout the country is about 20 tons of cane per acre, although there is some exceptional land that produces as high as 100 tons per acre under intensive cultivation. In the most modern plantations about $1\frac{1}{2}$ tons of centrifugal sugar are produced per acre. This, of course, varies greatly according to methods used and types of mills. The sugar produced is roughly divided into three classes, according to polarization, more or less, as follows: First class, 98°; second class, 85°; third class, 76°. The sugar must be consumed or exported each year as it is produced, as the extreme humidity during the rainy season causes it to sweat and become useless. Consequently, at the beginning of the harvest each year, the country has practically no store of sugar on hand. The best time for planting the cane is during the first two winter months of May and June, although planting may also be done in November, providing the soil can be irrigated, but this is rare.

The prices per 100 lbs. during the last few years have been as follows:—

Prices	1915	1916	1917	1918	1919	1920
Maximum..	\$5.50	.. \$5.50	.. \$6.00	.. \$8.50	.. \$10.50	.. \$19.50
Minimum..	4.75	.. 5.00	.. 5.50	.. 6.00	.. 8.50	.. 9.00

Sales in small quantities for domestic consumption are usually about \$1 per 100 lbs. higher than the wholesale export prices.

Nicaragua offers many advantages for the cultivation of sugar, particularly transportation facilities. The present Pacific Railroad taps the heart of the sugar country, carrying the sugar to Corinto, where is located one of the only two wharves on the Pacific coast of Central America. This eliminates entirely the danger of loss through handling on and off lighters in heavy weather, and the usual consequent damage due to wetting. Planters state the industry would be much further advanced were it not for the difficulty in obtaining money from the banks, the high rate of interest charged, and the discrimination in freight rates against sugar as compared with the prevailing rates on other sacked foodstuffs, such as rice, beans and similar articles by the railroad. The taking over of the controlling interest in the Pacific Railroad by the Government causes the planters to hope that they may soon obtain a more favourable classification for their product.

Most of the sugar machinery in the country is of British make, although American machinery has begun to come in. The company which produces over half the centrifugal sugar of Nicaragua has recently installed a large American mill, and some of the smaller producers are doing likewise. It is believed that American sugar machinery will be able to hold its own in the future against foreign competition. There are no refineries in the Republic.—[Consular Report, Dec., 1920.]

Publications Received.

Use of Colloids in Health and Disease. By Alfred B. Searle. (Constable and Co., Ltd., London.) 1920. Price: 8s. net.

Although this small work contains few original data, it is well worth perusing by students of colloidal chemistry, as a lucid exposition of a branch of the subject of great extent and of enormous importance. Preliminarily, it outlines in an elementary way for the use of the general reader matters such as the nature and properties of colloids; the colloidal nature of certain animal and vegetable fluids; the hygienic uses of colloids; and the application of colloids as germicides and disinfectants. Among other topics that are developed at some length by Dr. SEARLE may be mentioned the recognition of the essentially colloidal character of bacteria and their products (toxins). It is now realized that bacteria may be destroyed by substances which bear an opposite electric charge. The effect of an ordinary disinfectant on the bacteria present in a liquid is the result of their adsorption, forming either a chemical compound (as probably is the case with formaldehyde), or else a distribution of various phases in accordance with the well-known law of adsorption of colloids. Much valuable work in this direction has resulted from the discovery by the late HENRY CROOKES (son of the late Sir WILLIAM CROOKES) that colloidal solutions of certain metals, as silver, gold, arsenic, mercury, cobalt, etc., have a highly germicidal action while being harmless to human beings, even in relatively large amount. Possibly there is something to be learnt by the sugar factory chemist from a study of purification of sewage, which liquid like cane juice contains impurities in three different forms, namely: (a) in coarse suspension; (b) in colloidal solution; and (c) in true solution, though the proportions of these are very different in the two liquids. It has been found that the most successful method of sewage treatment relies upon the recognition of its colloidal character, and on the coagulation of the colloidal sol by the addition of some other substance carrying an electric charge of the opposite sign. Aluminium and ferric hydroxides have been found quite efficient for this purpose; but a cheaper method utilizes the fact that water agitated with air is positively charged, and in consequence is capable of effecting the coagulation of the negatively charged colloids, a precipitate being obtained which settles with extraordinary rapidity. We do not suggest that this process would prove applicable to the separation of the gums and pectins of cane juice, which colloids are likely to be of quite a different nature to those present in sewage; but it is nevertheless certainly of interest to study the methods by which problems apparently having a general resemblance to those on hand have been successfully solved. This small book forms an excellent introduction to the subject.

(1) **Introduction to General Chemistry.** (2) **A Laboratory Outline of General Chemistry.** By Herbert N. McCoy and Ethel M. Terry. (McGraw-Hill Publishing Co., Ltd., 6, Bouverie Street, London, E.C. 4.) 1920. Price: (1) 18s.; (2) 7s. 6d., net.

(1) This is a textbook which has been adopted in a number of colleges and universities in the United States, and has won commendation for the thoroughness of its system of teaching. It is noticeable that the choice and arrangements of subjects, particularly in the earlier part of the volume, depart from the familiar order to which one is accustomed in treatises covering the same ground. Thus, the first chapter deals with gas laws, and the following five develop the fundamental concepts of the science, namely the indestructibility of matter, elements, analysis of substances, the law of definite composition, and the derivation of formulae. Chapters 7-9 discuss acids, bases, and salts, and water and solutions; while 10 and 11 present the kinetic molecular and atomic hypotheses respectively, and therefore follow the development and use of formulae, instead of preceding them, thus emphasizing the fact that formulae are in no way of necessity dependent upon the molecular-atomic hypothesis. In subsequent chapters the ionic hypothesis; periodic system; theory of dilute solutions; disperse systems; radio-activity; and

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the nature of matter are discussed, besides which there are sections dealing with purely inorganic chemistry (nitrogen, phosphorus, sulphur and other compounds). This book may well be recommended as a reliable introduction to the study of general chemistry. It presents a continuous account of the subject in logical sequence, and the chapters on theoretical and physical chemistry are particularly well written. (2) This is a laboratory companion to the book just noticed. It gives instructions for carrying out experiments elucidating the principles developed in the first volume; and a notable feature is the series of questions following the instructions relating to manipulation, these being presumably for the purpose of developing the habit of observation and deduction, which faculties certainly are of supreme importance in the practice of experimental chemistry.

The Determination of Hydrogen Ions. By W. Mausfield Clark. (Williams and Watkins Co., Baltimore.) 1920. Price: \$5.

The importance of the precise regulation of the acidity or alkalinity of the juice, liquor, or syrup at the various stages of the manufacture and refining of sugar is fully recognized by sugar technologists, by reason of the risk of inversion on the one hand, and the possibility of damaging the colour on the other, while the collateral effects on filtration and precipitation are not to be ignored. The usual method of determining this acidity or alkalinity by titration, however, gives a measure of the quantity of the acid or alkali present and not of the activity or effective strength as is given by the hydrogen ion concentration. The latter is, therefore, a more exact measure of the influence on the sugar solution. In this book the methods are described of measuring hydrogen ion concentration, both by the use of indicators and by electrical means. Although more especially directed towards use in biochemical and physiological research, the details of the various methods are sufficiently full to enable the sugar chemist to adapt the method to his own particular requirements. After an introductory chapter on the general relations of acids and bases, an outline of the colorimetric method of using the various indicators is given, and the theory and choice of indicators, standard buffer solutions for colorimetric comparisons and approximate determinations with indicators are discussed. In the chapters devoted to the electrical method, the theory of the hydrogen electrode and its relation to the hydrogen ion concentration are developed, and a full description is given of the necessary equipment. There is a bibliography of 64 pages, of which the chapter on applications in research, routine and industry constitutes an index, and in the appendix are a number of useful tables.

Modern Research in Organic Chemistry. F. G. Pope, D.Sc., F.C.S. Second Edition. (Methuen & Co., Ltd., 36, Essex Street, London, W.C.) Price: 7s. 6d., net.

Dr. Pope's book (which is now almost too well-known to require introduction) presents in a concise form the development of some of the more important branches of organic chemistry. Its nine chapters discuss: the polymethylenes; the terpenes and camphors; the uric acid or purine group; the alkaloids; the relation between the colour and constitution of chemical compounds; salt formation, pseudo-acids and bases; the pyrones; ketens, ozonides, triphenylmethyl, and the Grignard reaction; and they embody the results of the most recent research work. A bibliography is given at the end of each chapter, so that the reader may be able to make use of the current literature of the topics dealt with in the text.

Das Trocknen und die Trockner (Drying and the Dryer). O. MARR; third edition by KARL REYSCHER; 544 pages and 283 illustrations. (R. Oldenbourg, München and Berlin). 1920. Price: M. 65.

Theorie der Heissluft-Trockner (Theory of the Hot-Air Dryer). W. Schule. (Julius Springer, Berlin.) 1920. 173 pages and 34 illustrations.

Review of Current Technical Literature.¹

DECOLORIZING CHARCOAL (ANIMAL AND VEGETABLE) BEFORE THE WAR. Wilder D. Bancroft. *Journal of physical Chemistry*, 1920, 24, 127-146; 201-224, and 342-366.

This is a useful review of the work done on animal and vegetable charcoal up to 1914 by different investigators from different points of view, among whom may be mentioned WALLACE,² STAMMER,³ SIENHOUSE,⁴ NEWLANDS,⁵ PATTERSON,⁶ and CLARK,⁷ though it contains few original data. In discussing the question of the rôle of nitrogen in animal charcoal, it is said that "there seems good reason to believe that a wood charcoal can be made having a higher decolorizing power than most animal charcoals, and perhaps higher than any animal charcoal, so that nitrogenous compounds are not necessary though they may be desirable. Since adsorption is specific, we must distinguish two factors, the nature and the structure of the surface. If a given surface will not take up a dissolved or dispersed substance, we can get results by impregnating with a third substance which is adsorbed strongly by the surface and adsorbs the dissolved or dispersed substance We can consider the nitrogenous compounds as mordants for the colouring matter in sugar. If we have a charcoal of low adsorbing power, the presence of the nitrogenous matter in suitable amount will increase the adsorption very much. If we have a charcoal with just the right structure for adsorbing a particular colouring matter, the addition of nitrogenous matter may clog the pores or disturb things otherwise so as to be positively detrimental People have realized that the porosity of the charcoal was important; but they have not asked themselves what was the proposed size or shape of pores to give the best results."

COLLOIDAL CUPROUS OXIDE. C. Paal. *Zeitsch. anal. Chemie*, 1920, 59, 166-167.

RUOSS recently said that colloidal cuprous oxide had never been mentioned, which statement is naturally controverted by the author. LOHRY DE BRUN⁸ prepared it 20 years ago, using gelatin as a protective colloid; while 14 years ago the author observed its appearance as an intermediate product in the formation of the red and blue modifications of copper hydrosol on reducing colloidal cupric hydroxide by means of hydrazine in presence of sodium protalbate or lysalbate.⁹

DETERMINATION OF REDUCING SUGARS BY WEIGHING METALLIC COPPER REDUCED BY MEANS OF METHYL ALCOHOL. C. A. Browne. *Journal of the Association of Official Agricultural Chemists*, 1919, Vol. III, No. 2, 263.

Dr. BROWNE reported to the Committee on Sugar of the A.O.A.C. that he had investigated a method of determining reducing sugars by converting the cuprous oxide to metallic copper. This is done instantaneously by igniting the crucible containing the cuprous oxide, and plunging it while still hot into the vapour of methyl alcohol. It will be remembered that a similar method, using ethyl alcohol, was advocated a few years ago by WEDDERBURN.¹⁰ Dr. BROWNE finds that the alcohol used for reduction should be changed frequently, since oxidation products may interfere with complete reduction to metallic copper; and further, that there is danger of decomposition of alcohol and deposition of carbon if the crucible is too hot, or the alcohol too strong. It is pointed out that the method is not one which can be depended upon in the hands of unskilled chemists. Its simplicity, however, renders it serviceable, and it is recommended to the Committee for further study.

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

² *Chem. News*, 17, 249.

³ *Chem. Centr.*, 1868, 13, 1002.

⁴ *Liebig's Ann.*, 1856, 101, 243.

⁵ *J. Soc. Chem. Ind.*, 1886, 7, 419.

⁶ *Ibid.*, 1903, 22, 608.

⁷ *Ibid.*, 1913, 32, 362.

⁸ *Recueil des Trav. Chim. des Pays-bas*, 1900, 19, 251. See also FISCHER AND HOOKER, *I.S.J.*, 1919, 76.

⁹ *Berichte*, 1902, 35, 2195; 1904, 39, 1550; 1906, 39, 1545; 1914, 47, 2195.

¹⁰ *I.S.J.*, 1915, 431. The method is also recommended in Spencer's "Handbook for Cane Sugar Manufacturers."

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RELATIVE EFFICIENCY OF ANIMAL AND VEGETABLE CHARCOALS IN ADSORBING DIFFERENT SUBSTANCES FROM SOLUTION. *D. van Os. Pharmaceutisch Weekblad, 1920, 57, 693-696.*

In the following table are ranged the adsorption capacities (in descending order) of various decolorizing agents towards different substances, in compiling which Wiechowski's methylene blue test¹ and Joachimoglu's iodine test² were used :-

METHYLENE BLUE.	CARAMEL.	IODINE.	QUININE SULPHATE.
Cellulose carbon.	"Norit."	Cellulose carbon.	"Eponit."
"Norit."	"Eponit."	"Eponit."	"Norit."
"Eponit."	Cellulose carbon.	"Norit."	Cellulose carbon.
Animal charcoal.	Animal charcoal.	Animal charcoal.	Animal charcoal.
Wood charcoal.	Wood charcoal.	Wood charcoal.	Wood charcoal.

USE OF BONE-BLACK (ANIMAL CHARCOAL) AND DECOLORIZING CARBONS IN SUGAR REFINING AND PLANTATION WHITE SUGAR MANUFACTURE. *W. D. Horne. Journal of Industrial and Engineering Chemistry, 1920, 12, No. 10, 1015-1017.*

Dr HORNE contributes an interesting review of the present position of this subject *Animal Charcoal*.—In America, the most desirable size of grain is 16 to 30 mesh, and in use not more than 20 or 30 per cent. between 30 and 40 mesh, or more than 5 per cent. finer than 40 mesh, should be allowed to accumulate. Regarding hardness, which is very important to enable grains to resist the abrasion of continued use, a satisfactory method of testing, described by Dr. HORNE about 1891, consists of shaking 25 grms. of the char in a covered round tin-can, 4 in. in diam., with six marbles, weighing 12.5 gm. each. After 200 rapid swirling revolutions, the material is sifted through a screen having round holes $\frac{1}{16}$ in. in diam., and the increase of dust thus indicated should not exceed about 2 per cent. In discussing the chemical and physical action of decolorizing by means of char, reference is made to the opinion of Sir J. J. Thomson that mineral salts are absorbed largely through surface attraction, modified by the internal and surface tensions of the solvents and the substances dissolved. Char is said not to decolorize cane juice satisfactorily; and at times it yields an inky or a pinkish filtrate in refineries, owing apparently to the presence of polyphenol compounds of iron. There is thus an apparent failure on the part of char to remove iron salts from solution. Indeed, what little iron a char may accumulate in filtering high-grade liquors will slowly be removed under the action of low-grade solutions, as though the mineral salts in the latter exercised a specific iron removal. Lately, efforts have been made to activate old char by subjecting it to the action of steam under high pressure, taking advantage of experience gained during the war in the preparation of gas-mask carbon. A char thus treated when freshly used had a considerable colour absorption in the case of a dark syrup. After washing out the sugar, and boiling up with 1 per cent. hydrochloric acid, and again washing, it had no effect; but after boiling up with sodium hydroxide solution, and washing, it showed a very decided power to absorb colour.

Decolorizing carbons.—After discussing preparations as "Norit" and "Eponit," it is said that they are generally 10-20 times as efficient in taking up colour as char, suggesting that the 10 per cent. or so of carbon in the latter is the only decolorizing substance present; but this conclusion is wrong, as char almost entirely decarbonized by burning still possesses a considerable colour absorbing power. Figures obtained in the laboratory show that the different colouring substances in sugar products require different agents for their absorption to give the best results. It would seem also that successive treatments with different decolorizers might give greatly augmented effects, but thus far results have been disappointing. Concluding, Dr. HORNE says that "the desideratum is a decolorizing carbon cheap enough to throw away after using once, and which will absorb 10-20 times as much colour as bone-black, and ash and organic impurities in proportion. This may not come, but the advance has been so rapid that we may not unreasonably expect to see

¹ *Zeitsch. Allgem. oet. Apoth. Ver.*, 1914, 488.

² *Biochem. Zeitsch.*, 1918, 77, 1-13.

some approach to it in the not distant future. It remains for the subject to be followed up industriously to attain results that will amply repay all efforts in the investigations of these fascinating questions."

STANEK'S METHOD OF USING DECOLORIZING CARBON ("CARBORAFFIN"). *Vlad. Skola. Zeitschrift für Zuckerindustrie der Czechoslovakischen Republik, 1920, 45, No. 13, 89-95.*

Stanek's method of using decolorizing carbon ("Carboraffin,"¹) namely to pass the liquor to be treated through a layer of it in the form of a cake in a filter-press, has been examined from different points of view; and the following results have been obtained: (1) During the operation of sweetening off, the quotient of purity falls at first rather slowly, due to the presence of the treated liquor between the particles of carbon, but after this residual solution has been expelled, the purity of the wash-waters falls more rapidly. It is recommended that this liquor remaining in the interstices of the cake should be forced out by means of steam previous to commencing washing with water. (2) Regarding the amount of water necessary for sweetening off, this is stated to be 1000 per cent., calculated on the weight of the carbon. (3) As the result of sweetening off, a certain amount of colour is re-dissolved by the water; and in two experiments this was found to be 3.6 and 3.8 per cent. of the total amount of colour which had been adsorbed by the decolorizing carbon, the alkalinity of the water used exerting an influence, as one would expect. (4) A comparison with animal charcoal was made. The amount of char necessary for the treatment of certain beet sugars was found to be 8 per cent. of the sugar in process; and the amount of water for sweetening off was 200-300 per cent. of the weight of char, that is, 16-24 per cent. on the sugar used. On the other hand, the water employed for sweetening off "Carboraffin" was 1000 per cent., as stated, that is, 0.7 per cent. on the weight of sugar when using 0.07 per cent. of carbon, also on the weight of sugar. As to the loss of sugar occurring, this is stated in char work to be 0.18 per cent. again calculated on the sugar; while in the case of "Carboraffin" it is 0.03 per cent. Comparative observations of the fall of purity during sweetening off were also made. In char work when the density of the water has reached say 2.07° Brix, the quotient may average 39.1²; whereas when operating with "Carboraffin" when the wash-water has arrived at the same density the purity is 87.6°. In regard to the rate of sweetening off, for char and carbon the times observed were 15-30 and 8 mins. respectively. In short, the advantages of Stanek's method of using "Carboraffin," compared with char filtration are stated to be (a) that the amount of water necessary for sweetening off is at least 10 times less, while the loss of sugar is six times less; (b) that the quotient of purity of the wash-water falls more slowly; and (c) that the duration of filtration is incomparably shorter.

INCREASE IN THE QUOTIENT OF PURITY EFFECTED BY THE DEFECATION, SULPHITATION, AND CARBONATION PROCESSES OF CLARIFICATION. (1) *J. S. de Haan. Archief voor de Suikerindustrie in Nederlandsch-Indië, 1919, 27, 1897-1906.* (2) *A. Schweizer. Ibid., 1919, 27, 2013-2016.*

(1) Generally in Java in determining the quotient of purity due to clarification the sample of raw mill juice is allowed to stand for half-an-hour before taking its Brix, in order to allow the suspended matter to subside and the entangled air to escape. According to Mr. DE HAAN, the correct method of working is to filter juice, either by passing it through paper (which is a very slow procedure, liable to cause error owing to evaporation), or else by employing double centrifuging in a Sharples machine. If the raw juice be preliminarily filtered in either way, it will be found that the increase in the quotient of purity owing to clarification is 1.6° for carbonation, 0.3° for sulphitation, and also about 0.3° for defecation. (2) Mr. SCHWEIZER, however, says that it is not right previously to filter the raw juice, because it gives a liquid that does not correspond at all to that entering the factory, and

¹ Protected by the Verein der Zuckerindustrie in Böhmen in German Patent, 317,449; *J.S.J.*, 1921, 113.

² Wohryzek's "Chemie der Zuckerindustrie," 602.

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itself effects a certain clarification. Filter paper adsorbs certain impurities; while high-speed centrifuging throws down others. There appears, nevertheless, to be no reason why a centrifugal machine might not be used for the removal of the suspended matter in the raw juice, provided its speed be not more than 2000 revs. per min.

DETERMINATION OF GLUCOSE (REDUCING SUGARS) AND STARCH BY THE ALKALINE POTASSIUM PERMANGANATE METHOD. *Francisco A. Quisumbing. Philippine Journal of Science, 1920, 16, No. 6, 581-599.*

Different workers have experimented on the possibility of determining sugars (and other organic substances) by oxidation with potassium permanganate, among whom may be mentioned BERTHELOT,¹ SMOLKA,² KAREZ,³ and GREIFENHAGEN, KÖNIG and SCHOLL.⁴ DONATH and DITZ⁵ concluded that whereas in an acid medium carbon dioxide and water are obtained, in an alkaline solution oxalic acid mainly results, an opinion that was in agreement with the results published by WITZEMANN.⁶ Mr. QUISUMBING has now further examined this method; and his study of the conditions of the reaction shows the optimum concentration of reagents to be 0.1N potassium permanganate (at which strength the oxidation of non-sugars substances is less than with stronger solutions), and 0.04N alkali (at which strength the amount of permanganate required increases uniformly with increasing amounts of glucose from 1 to 40 mgrms.), the procedure elaborated on these results being as follows: 50 c.c. of 0.1N potassium permanganate, 25 c.c. of a solution of sodium carbonate (containing 8.48 grms. per litre), and 25 c.c. of the glucose or hydrolysed starch solution are placed in an Erlenmeyer flask. This liquid is so heated that its temperature is raised from 29° to 95°C. in 2 min., heating being continued for another 2 min. after 95°C. is reached. At the end of this time, 25 c.c. of 28 per cent. sulphuric acid and 25 c.c. of 0.1N oxalic acid are gradually added, and the excess of oxalic acid remaining is titrated with 0.1N permanganate until the liquid retains a pink colour for a few seconds. On subtracting the number of c.c. of oxalic acid from the c.c. of permanganate used in oxidation and in titration, the total number of c.c. of permanganate used in oxidation is obtained, the amount of glucose being calculated by means of the following table, while for the calculation of starch the factor 0.93 (stated by NOYES⁷ to be more correct than 0.9) is used.

0.1N potassium perman- ganate. c.c.		Glucose, mgrms.	0.1N potassium perman- ganate. c.c.		Glucose mgrms.	0.1N potassium perman- ganate. c.c.		Glucose mgrms.	0.1N potassium perman- ganate. c.c.		Glucose, mgrms.
5.40	..	4	16.93	..	14	28.48	..	24	38.24	..	34
6.54	..	5	17.85	..	15	29.47	..	25	39.38	..	35
7.68	..	6	18.77	..	16	30.46	..	26	40.52	..	36
8.76	..	7	20.13	..	17	31.67	..	27	41.05	..	37
9.84	..	8	21.49	..	18	32.88	..	28	41.58	..	38
11.08	..	9	22.74	..	19	33.81	..	29	42.22	..	39
12.32	..	10	23.99	..	20	34.75	..	30	42.86	..	40
13.45	..	11	25.13	..	21	35.80	..	31	43.35	..	41
14.58	..	12	26.28	..	22	36.86	..	32			
15.76	..	13	27.88	..	23	37.58	..	33			

Application of the method to pure glucose gave 100.2 and 99.04 per cent. in two different samples, the corresponding results by Munson and Walker's method being 99.89 and 99.20 per cent. In the case of samples of corn and cassava starch (conversion to glucose being effected by means of acid), the new process gave results about 0.65 per cent. higher; while in that of arrowroot, rice, and banana flours the difference was as much as 10 per cent., due doubtless to the oxidation of organic non-sugars present as impurities. When, however, the hydrolysis of the starch was effected by means of the enzymes

¹ *Ann. d. Chem. u. Pharm.*, VI., No. 181.

² *Monatsch. f. Chem.*, 1887, 8, 1.

³ *Osterr.-Ungar. Zuckertnd.*, 1891, 20, 698.

⁴ *Biochem. Zeitsch.*, 1911, 35, 169.

⁵ *Journ. f. prak. Chem.*, 1899, 60, 568.

⁶ *J. Amer. Chem. Soc.*, 1916, 38, 157.

⁷ *Ibid.*, 1904, 26, 206.

diastase (from malt) or ptyalin (from saliva) the permanganate process gave results both in starches and flours closely agreeing with those found by the Munson and Walker method.

BIOCHEMISTRY OF THE MOWRA (MOHWA OR MAHUA) FLOWER. *G. J. Fowler, J. D. E. Behram, and others.* *Journal of the Indian Institute of Science*, 1920, 3, 81-118; through *Journal of the Society of Chemical Industry*, 1921, 40, No. 1, 22-23A.

These studies were made with a view to the utilization of this plant as a source of industrial alcohol, a matter that has already been commented upon from the economical point of view.¹ Dextrose, levulose, maltose, sucrose, pentoses, and cellulose were identified, the total sugar being greatest when the flowers are ready to fall, at which stage it amounts in general to 60-70 per cent. In the growing stages levulose is present in greater amount than dextrose, but in the final stages the quantities approximate but do not become equal. Sucrose increases in amount up to the shedding of the corolla, but after this and during storage it decreases relatively to invert sugar. Numerous enzymes were detected at various stages of growth of the flower; maltase, catalase, and oxidase were present throughout. Yields of alcohol up to 90 per cent. of the theoretical were obtained by fermentation of a mash of the flowers with cultures of the natural yeast occurring in the flower, and the addition of such reagents as sulphuric acid and ammonium phosphate. By increased care in the cultivation, collection, and storage of the flowers, a greater yield per tree, and a greater percentage of total sugar, and particularly of sucrose, should be possible of attainment.

EVALUATION OF SODIUM HYDROSULPHITE. *R. Fohrmals* *Chemiker Zeitung*, 1920, 140 809.

Some further particulars are given regarding the ferrocyanide method of determining hydrosulphite.² If a solution of potassium ferricyanide is allowed to run into a solution of sodium hydrosulphite, the reaction which occurs is as follows: $3K_3Fe(CN)_6 + Na_2S_2O_4 \cdot H_2O + H_2O = 2K_2NaFe(CN)_6 + 2H_2SO_3$, the end point being recognized by means of a drop of ferrous ammonium sulphate solution giving Turnbull's blue. Sulphurous acid does not react with the ferrocyanide in the cold, and it is stated that altogether the method is a convenient and reliable one. In carrying it out, a N. 10 solution of potassium ferricyanide is prepared by dissolving 32.92 grms. of the pure salt in a litre, and 1 c.c. of this liquid according to the above equation is equal to 0.0096 grm. of $Na_2S_2O_4$; 0.5 grm. of the sample under examination is dissolved in about 50 c.c. of air-free water; and a few drops of a 10 per cent. solution of ferrous ammonium sulphate added, the ferrocyanide solution being added from a burette until a permanent bluish-green coloration is formed. Working according to this procedure, it was found that 0.5 grm. of B. A. S. F. concentrated sodium hydrosulphite required 43.53 c.c., so that 1 c.c. of the ferricyanide solution corresponds to 0.0115 grm. An unknown grade of hydrosulphite gave 37.47 c.c., so that taking the B. A. S. F. preparation as 100 per cent., the content of the unknown material is $37.47 \times 0.0115 \times 200 = 86.18$ per cent.

CHEMICAL INDICATORS. *Anon.* *Chemical Trade Journal*, 1921, 68, No. 1755, 42.

Recent useful developments in the field of chemical indicators have arisen from the increasing recognition of the great influence which the degree of acidity or H-ion concentration has upon various biological processes. *SORENSEN, ROWNTREE, LUNS and CLARK*³ and others have taken prominent part in this work, and the last-named two investigators were successful in obtaining a series of new and brilliant indicators, which left little to be desired for H-ion concentration between 10^{-1} and 10^{-10} . Most of these compounds are of the sulphophthalein series, excepting methyl red, propyl red, and cresolphthalein. It is worth noting by the sugar factory chemist that *KOLTOFF*, of

¹ See *I.S.J.*, 1920, 282 and 414.

² *I.S.J.*, 1920, 413.

³ *Journal of Bacteriology*, 1917, II, Nos. 1, 2, and 3; 1920, V, No. 2.

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Utrecht, has stated that phenolphthalein paper reacts very slowly unless the spot is rubbed with a glass rod, and he suggests this difficulty may be due to the fact that phenolphthalein crystallizes out on the paper. Phenolphthalein paper and phenolphthalein solution are known to give slightly different indications.¹ Whether this conjecture is correct or not, the irregularity was not to be encountered in the use of thymolsulphophthalein on account of its greater solubility in water. Although litmus is the most extensively used of all indicator test papers, it is also the most unreliable. Being a natural product and a mixture of substances, its purity and consequent sensitiveness vary with the mode of preparation. As a substitute for litmus, either of two indicators of the sulphophthalein series can be used namely, dibromocresolsulphophthalein or dibromothymolsulphophthalein. The former changes from yellow to a brilliant purple, and the latter from yellow to a brilliant blue. Both can be obtained in very pure condition, and consequently a uniform product is assured. It may be stated that for general laboratory use, if only two indicators are to be selected, methyl red and thymolsulphophthalein will be sufficient for most of the titrations and rough controls which the average chemist needs to make, but the complete series would be desirable when the highest precision and accuracy are to be attained. A more general and intelligent use of indicators would be productive of increased efficiency in many industrial operations.²

HABIT IN SUGAR CANES. *U. Vittal Rao. Agricultural Journal of India, 1920, 15, Part IV (July). (Paper read at the 7th Indian Science Congress, Nagpur, 1920.)*

The writer gives numerous details as to the good or bad habit of the different groups of Indian canes, including J 247 in the series for the sake of comparison. The canes were all grown at the Coimbatore Cane Breeding Station, and the notes which have been continued for some years and which are very full are based upon a paper read at the Indian Science Congress at Madras in 1916.³ The letterpress is short and the paper is fully illustrated by excellent photographs and a series of tables and curves, which make it very easy to read. Erectness of the bushes and straightness of the individual canes are the characters here dealt with, and it is pointed out how important these characters are from the crop point of view. In both of them the members of the Saretha group are extremely unsatisfactory whereas those of the Nargori group are the opposite; Mungo and Pansahi occupy an intermediate position, their habit generally very fair, while J 247 is distinctly good. Straightness has been recorded at crop time for some years and is judged in the following manner: One hundred canes of each variety are laid out at crop time on the ground, and these are classified roughly into three sets, perfectly straight, slightly curved (usually at top and bottom), and markedly curved. The hundred canes of J 247 are generally straight, while Mungo has 94.4 per cent., Nargori 85.3 per cent., Pansahi 63 per cent. and Saretha only 4.3 per cent.; only Saretha has markedly curved canes, and this to the extent of 50 per cent. The inheritance of bad habit was early recognized in the raising of seedlings at Coimbatore, for the members of the Saretha group, following the success obtained by Kobus in Java with *Chunnee* as male, received very considerable attention at first, as they had much to be said for them in hardiness and vigour. Habit was found to be one of the characters which was handed down from parent to child in a marked degree and this was specially noted in the Saretha group. Interesting confirmatory details are given in some of the tables in the present paper, while a picture is given of the truly atrocious habit of the seedlings of the Punjab *Katha* cane, the most primitive member of the Saretha class and nearest to *Saccharum spontaneum* in India. The various curves and tables are well worth study by those interested in this aspect of the raising of cane seedlings, and a memoir is referred to for further details.⁴

¹ *I.S.J.*, 1920, 705.

² See also *I.S.J.*, 1921, 103.

³ "The Depressed Habit in Sugar Canes." C. A. BARBER and T. S. VENKATARAMAN.

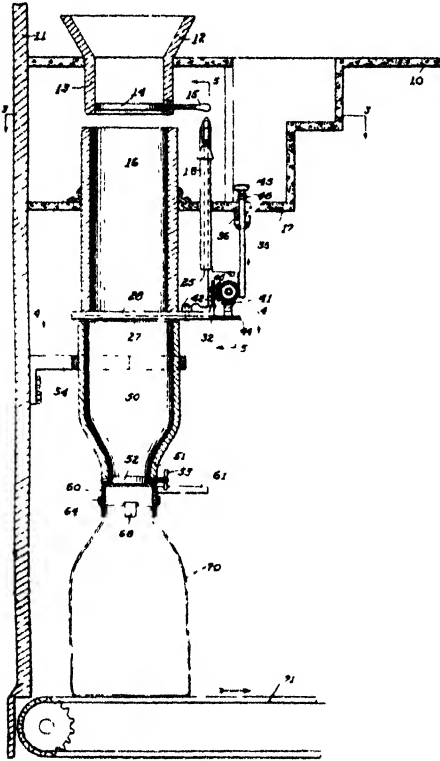
⁴ "Studies in Indian Sugar Canes. No. 2." *Memoirs of the Department of Agriculture in India, Botanical Series* 1916, 8, No. 3 (July), 136-139.

Review of Recent Patents.¹

UNITED STATES.

APPARATUS FOR PACKING AND WEIGHING SUGAR IN BAGS. *Joseph Zakarka, of Brooklyn, New York, U.S.A. 1,350,130. December 30th, 1919; August 7th, 1920. (Five figures.)*

Referring to the drawing, 10 indicates a portion of one of the floors of a refinery, and 11 one of the vertical walls. Supported on the floor 10 is a hopper 12 having its discharge mouth extended downwardly through the floor in the form of an extension 13. At the lower end of this extension 13 is a door 14 provided with a handle 15 whereby it may be opened or closed. Located in axial alinement with the discharge mouth of the hopper is a cylindrical measuring chute 16 of slightly larger diameter. Supported by the platform 17 is a weighing device of the steelyard type, commonly referred to as a scale.



The pan of this scale extends under the chute 16 and normally closes the lower end thereof. The frame of this scale comprises a hollow post 18 extending through and suitably supported by the platform 17 and having a lateral lug on its upper end to which is fulcrumed a scale lever of the usual type provided with the movable balance weights. Suspended from the inner end of the lever is a rod which extends freely through the post 18, and has a rigid foot 22 on its lower end to which the pan is secured.

Regarding this pan, it comprises a pair of semi-circular halves 27 and 28, which, when together, close the bottom of the chute 16. Means are provided (described in detail in the original specification) for separating the halves of the pan by pressure on the head 45 by the foot of the operator, thus discharging the weighed contents of chute 16. Below this chute 16 in axial alinement therewith is a delivery funnel 50 whose upper end is spaced below the lower end of the chute 16 just sufficient distance to accommodate the pan of the scale, the upper portion of this funnel being slightly larger than the chute, the

funnel tapering down to a restricted neck 51 provided with a swinging door 52 operable by a handle 53. This funnel may be supported by a bracket 54 fixed to the wall 11.

The bags to be filled are secured to oval rings 60 fixed on the ends of arms 61 radiating from a hub on a standard. Hinged to one side of each of these rings 60 is a clamp made up of a pair of curved fingers 64 which jointly encircle the ring, and have handles on their outer ends adapted to be secured together by means of a hook engaging a pin. This device is so located that when swung on the standard the bags are brought

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Patents.

under the funnel 50, the rings 60 being slightly larger than the mouth of the latter. When filled, the bags are placed upon an endless conveyor 71, one end of which extends under the apparatus.

BEEF TOPPERS. (1) *John Devey*, of Lehi, Utah, U.S.A. 1,351,287. December 18th, 1918; August 31st, 1920. (2) *C. L. Leonard and A. F. Howard*, of Ionia, Mich., U.S.A. 1,353,403. December 17th, 1918; September 21st, 1920. (3) *G. H. Smith*, of Columbus, Ohio, U.S.A. 1,354,857. November 7th, 1916; October 5th, 1920.

BEEF TOPPER AND HOE COMBINED. *Carl J. Thim*, of Logan, Utah, U.S.A. 1,361,201. September 30th, 1919; December 7th, 1920.

BEEF PULLER. *V. Kosenko*, of New Brunswick, N.J., U.S.A. 1,354,111. March 5th, 1920; September 28th, 1920.

BEEF LOADING MACHINE. *Frank Jones*, of Logan, Utah, U.S.A. 1,386,529. August 8th, 1919; October 26th, 1920.

BEEF HARVESTER. *Louis O. Graham*, of Logan, Utah, U.S.A. 1,357,163. October 28th, 1916; renewed, March 19th, 1920; October 26th, 1920.

PRODUCTION OF A HIGHLY ACTIVE DECOLORIZING CARBON FROM SULPHITE WASTE LIQUOR. *Arthur Knöppmacher* (Assignor to the *Chemical Foundation*, Me., Delaware, U.S.A.). 1,358,162. November 9th, 1920.

Claim is made for "the process of producing a highly active decolorizing carbon which comprises neutralizing the waste liquor from the sulphite cellulose treatment, using an alkali earth base, evaporating to dryness, and heating to redness."

PRODUCTION OF FERMENTABLE SUGARS. *George H. Tomlinson*, of Niagara Falls, Ontario, Canada. 1,358,398. June 13th, 1917; November 16th, 1920.

Claim is made for "the process of producing fermentable sugars from cellulosic material which consists in heating it in a closed vessel in contact with a hydrolysing agent until fermentable sugars are formed, and then quickly reducing the pressure in the vessel below atmospheric pressure, and finally distilling off the valuable products of the reaction."

PRODUCTION OF ACETATES AND ACETONE FROM CARBOHYDRATE MATERIAL (SUGARS, MOLASSES, STARCH GLUCOSE, ETC.). *James W. H. Randall* (*Industrial Chemical Co.*, of New York, U.S.A.). 1,338,040. June 27th, 1917; April 27th, 1920.

Starch glucose, cane syrup, etc., at a density of 1.5, is treated with a solution of sodium hydroxide at a density of 1.4 in such a proportion that the alkali is about 40 per cent. on the weight of actual carbohydrate. While hot the causticized solution is incorporated with powdered quicklime, the quantity of which should be 40-50 per cent. of the mixture of carbohydrate and sodium hydroxide. A porous mass results, and it is heated at 270-270°C. out of contact with air under pressure for 5-6 hours, at the end of which time it is cooled and the acetates extracted by heating, or dry-distilled to give acetone.

PURIFICATION OF BEET MOLASSES. *Walter D. Bonner*, of Salt Lake City, Utah, U.S.A. 1,362,078. October 12th, 1917; December 14th, 1920.

Claim is made for a process of purifying beet molasses, comprising suitably diluting with water, adding sufficient tartaric acid to precipitate the bulk of the potassium as acid potassium tartrate, separating the liquid from the precipitate, and lastly evaporating in order to induce the further formation of the tartrate.

CENTRIFUGAL MACHINE.¹ *William McChesney*, of London. 1,362,712. August 11th, 1920; December 21st, 1920.

RECOVERY OF POTASH AND OTHER BY-PRODUCTS FROM STEFFEN'S WASTE LIQUOR. *George M. Bradford and James E. Broadhead*, of Bay City, Michigan. 1,342,737 (serial No. 254,304). September 16th, 1918; June 8th, 1920.

Steffen waste liquor is concentrated to 30° Bé., subjected to "the action of an electric current of sufficient intensity to produce an arc;" the gaseous products (dimethylamine, trimethylamine, cyanogen, etc.) cooled and recovered; and the potash extracted from the solid mass obtained.

FILTER. *Peter C. Forrester*, of West Tacoma, Washington, D.C., U.S.A. 1,349,056 March 22nd, 1919; August 10th, 1920.

This invention contemplates the provision of a suitable reservoir in which the solution (of sugar, etc.) is held and maintained at a constant level, a pair of filtering devices, each composed of a plurality of filtering members which are adapted to be alternately projected into and out of the reservoir, means for automatically applying suction to the filtering members to strain the liquids therethrough, means for automatically drying the solid portion of the solution, means for removing the dried cake from the filtering members, and means for automatically governing these operations.

ADHESIVE COMPOSITION, CONTAINING STARCH, GLUCOSE, AND GLUE. *Orlando V. Fontz*, of Vacaville, Cal., U.S.A. 1,360,915. September 20th, 1919, Nov. 30th, 1920.

Claim is made for an adhesive composition comprising a major portion of glue and tapioca, and a minor portion of sodium chloride and glucose in combination with sufficient solvent to reduce the mass to a paste.

FERTILIZER CONTAINING NITROGEN AND PHOSPHORIC ACID. *Philip C. Hoffmann* (Assignor to *Virginia-Carolina Chemical Co.*, of Richmond, Ver., U.S.A.). (1) 1,360,401. (2) 1,360,402. June 19th, 1920; November 30th, 1920.

(1) Claim is made for the use as a fertilizer of the product resulting from the reaction between calcium cyanamide and concentrated phosphoric acid. (2) Claim is made for the process of preparing a fertilizer by treating calcium cyanamide with dilute phosphoric acid.

EVAPORATOR AND CONDENSER. *Frank H. Schubert* (Assignor to *Brown-Ferrier Co.*), Wilmington, Del., U.S.A. 1,361,910. March 28th, 1919; December 14th, 1920.

An evaporator and condenser having a body member made up of a single casting are described. It comprises an evaporating body having a central portion of its bottom pierced to form a tube-sheet, a cylindrical upwardly extending member surrounding said tube-sheet portion and lying within evaporating body, and a cylindrical downwardly extending member also surrounding said tube-sheet portion and forming the body of the condenser.

PREPARATION OF AN ADHESIVE COMPOSITION FROM STARCH. *Walter Alexander*, of New York, U.S.A. 1,337,382. March 13th, 1917; April 20th, 1920.

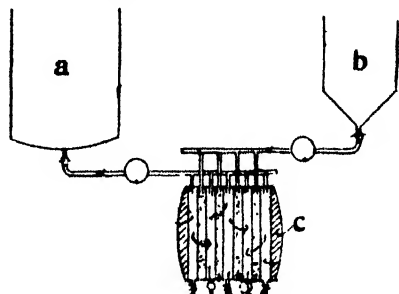
A composition which is hard when cold, which liquefies with heat; which is highly adhesive; and which dries rapidly without being tacky is prepared by heating together 100 lbs. of water and 50 lbs. of commercial starch, treating with a converting agent (such as charcoal, sodium peroxide or a suitable acid, which is subsequently neutralized) until the mixture flows thinly while hot, and finally adding 50 lbs. of dry calcium chloride. This substance may be used as a glue substitute, a filter for cloth, a binder, and generally for all purposes for which adhesives are employed. It is oil and grease proof, and its cost of preparation is small.

¹ Cf., U.K. Patent, 142,949; *I.S.J.*, 1920, 532.

GERMANY.

APPLICATION OF DECOLORIZING CARBON ESPECIALLY FOR THE TREATMENT OF SUGAR JUICES. *Verein der Zuckerindustrie in Böhmen, Prague. 317,449. August 1st, 1917.*

"Carboraffin"¹ or a similar preparation of decolorizing carbon, is deposited from a mixture with water or sweet-water in the frames of a filter-press, and the juice or other liquid under treatment is passed through this cake. Thus, on mixing together 1 litre of clairoe and 2.0 grm. of "Carboraffin" for 80 min., and rapidly filtering at the end of this time, a decolorization of 26 per cent. was obtained. When, however, the same amount of clairoe was filtered through the same amount of carbon spread over a surface of 20 sq.



cm., taking the same time in so doing, the decolorization was 44.5 per cent. Referring to the sketch, *b* is a conical vessel containing water or sweet-liquor mixed with the carbon, which liquor after settling a little is allowed to enter the frames of the filter-press below, first the coarse and then the fine particles of carbon depositing on the cloths. When the frames are full, the valve controlling the supply is closed, and the liquor to be decolorized is pumped from the tank *a* into the spaces between the frames. When the power of the

carbon is exhausted, the liquor is forced out of the press by steam or air, and the cake washed with water, following which it is revived. It is stated that since the heavier particles of carbon are deposited before the very fine ones, the filtrate is clear from the first moment of the operation; that the maximum decolorizing effect is realized in a convenient manner; and that less water is required for sweetening off than in the method employed hitherto. The rate of filtration in a press having frames 25 mm. thick under a pressure of 2 atmos. amounts to about 500 litres per hour per sq. m. of surface.²

UNITED KINGDOM.

MOTOR FUEL CONTAINING ALCOHOL. *C. G. Sesti, of Rome, Italy. 147,803 (19,846).*

July 9th, 1920; convention date, May 31st, 1919; *not yet accepted*; abridged as open for inspection under Section 91 of the Act.

A motor spirit consists of ethyl, methyl, or other alcohol or "brandy or other alcoholic spirit mixed with carbon bisulphide that has been treated with chalk or similar substance."

SYRUP, JELLY, OR "MARMALADE" MANUFACTURE. *C. and O. Biemann, of Magdeburg, Germany. 147,838 (19,887). July 9th, 1920; convention date November 24th, 1916; not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Syrup, jelly, and conserve or "marmalade" are produced by passing liquors such as molasses (diluted and purified if necessary) through a series of diffusion vessels containing appropriate vegetable substances. An example of the process is described in which beet molasses is diluted with an equal quantity of water, purified with gelatinous silicic acid,³ and passed through six diffusion vessels in series. The first two vessels contain slices of beetroot, the third young vine shoots, the fourth stalks of rhubarb, and the fifth and sixth dried apple parings or the like. The liquid is drawn off in stages: (1) an amount equal to the contents of one of the vessels, which solidifies into a jelly, and (2) a similar amount which forms a syrup, with or without concentration. The material in the vessels is then broken up and mixed and forms a conserve or "marmalade." Other fruits or vegetables may be used, and in particular the leaves of nut-bearing trees may replace the vine shoots.

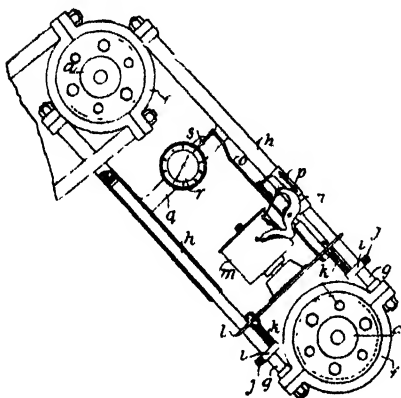
¹ *I.S.J.*, 1919, 168, 342.

² *Cf. also I.S.J.*, 1921, 106.

³ *I.S.J.*, 1921, 54.

AUTOMATIC APPARATUS FOR RECORDING THE CLEARANCE BETWEEN THE ROLLS OF A CANE MILL. *Naamlooze Vennootschap Suikercultuur Maatschappij*, of Amsterdam, Holland, (assignee of *T. G. A. Almerood*, of Besoeki, Java). 150,959 (25,978). September 9th, 1920; convention date, September 9th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

In regard to cane mills which are provided with automatic apparatus for recording and directly indicating the clearances or distances between the rolls, the movements of



each of the bottom rolls relatively to the top one are inscribed upon a paper drum driven by clockwork, while the clearances are indicated by a meter. A fixed adjustable disc *a* mounted on the free end of each bottom roll is surrounded by a divided adjustable ring *f* carrying rods *g* which are adapted to slide in hollow rods *h* carried by the rings *f* of a similar disc *a* on the top roll. A plate *l* carrying an indicator-drum *m* and a scribing device *n* is secured to the rods *g* by means of adjustable plates *i* and screws *j*. As the distance between the rolls increases, the rods *g* move out of the rods *h* and an arm *p* on one of the rods *h* operates the device *n*. At the same time, a rod *o* carried by the plate *l* moves the lever *s* of a meter *r* mounted on a cross-member *q* connecting

the rods *h*. The meter *r* indicates the actual clearance between the rolls.

CONFECTIONERY COATING MACHINE. *National Equipment Co.*, of Springfield, Mass., U.S.A. 151,227 (21,672). June 5th, 1919.

In a machine for coating articles with chocolate, etc., the material is drawn from the supply tank by a pump or other means which is reversible in order to return excess material from the pipe system to the tank when the coating operations are finished. The invention is described in connexion with the coating machine referred to in U.K. Patent, 150,799.¹

CONTINUOUS SPECIFIC GRAVITY (BRIX) RECORDING APPARATUS. *F. L. Halliwell*, of Mill Hill, London. 149,448 (12,479). November 17th, 1919.

This patent relates to apparatus of the type in which a float is suspended in the fluid by a wire attached to a balance lever connected to a multiplying lever carrying a pen in contact with a recording cylinder.

TREATMENT OF BEETROOT FOR USE IN MAKING MARMALADES, BEER, ETC.² *Betavit Ges. (August Aumann)*, of Berlin. 147,713 (19,707). July 8th, 1920; convention date, December 13th, 1917; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

To render beets suitable for use in "marmalades," juices, extracts, wines, beers, coffee-substitutes, etc., the heated beet mash is treated with steam at or above 100° C. The beets, after cleaning and shredding, are agitated and heated to about 55° C. and allowed to remain at this temperature for about an hour, when the agitating mechanism is re-started and the steam blown through for an hour or two. The steam is preferably introduced through a perforated pipe passing down the side and across the bottom of the vessel used.

¹ I.S.J., 1921, 57.

² See also I.S.J., 1920, 584.

Patents.

BEEF HARVESTER. *Georges Saur*, of Paris, France. 149,462 (13,043). May 23rd, 1919; August 19th, 1920. (Two figures.)

SACCHARIFICATION OF CELLULOSE. *A. Wohl*, of Langfuhr, Dantzic. 146,455 (18,526). July 3rd, 1920; convention date, March 14th, 1917; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Soluble carbohydrates obtained from materials containing cellulose by treatment with concentrated sulphuric or hydrochloric acid are lixiviated in a counter current, and separated from the conversion acids by a diffusion process similar to the "molasses osmose" process. Sufficient acid is allowed to remain with the carbohydrates for complete hydrolysis during subsequent heating; or the acid may be removed as fully as possible, and the solution neutralized, evaporated to dryness, and used as fodder.

FUMARIC ACID. *C. Wehmer*, of Hanover, Germany. 146,411 (18,400). July 2nd, 1920; convention date, September 21th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Fumaric acid is obtained by fermenting sugars (sucrose, dextrose, maltose, etc.) by means of *Aspergillus fumarius*, a description of which is given. The fermentation is effected in the presence of chalk or other neutralizing agents: the resulting calcium fumarate being converted into the free acid by means of sulphuric acid, or into lead fumarate which is subsequently decomposed by sulphuretted hydrogen.

CENTRIFUGALS. *P. T. Sharples*, of St. Davids, Penn., U.S.A. 148,763 (18,472). July 3rd, 1920; convention date, July 30th, 1919; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

PREVENTION OF INCRUSTATION IN BOILERS, ETC. *O. Rummel*, of Berlin. 148,778 (20,602). July 10th, 1920; convention date, April 14th, 1918; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Incrustation of boilers, heaters, etc., is prevented by adding to the water finely-divided graphite or carbon, or finely-divided metals such as zinc or aluminium, and connecting the walls of the boiler, etc., to the negative pole of a source of electricity, an electrode connected to the positive pole being immersed in the water.

BOILING PANS FOR CONFECTIONERY MANUFACTURE. *R. S. McColl, T. M. McColl, and T. F. Dryden*, of Glasgow. 149,172 (30,772). December 9th, 1919.

An installation primarily for the manufacture of confectionery comprises a number of pans grouped in rows, a water-containing vat common to each row heated by the injection of steam, means for raising and lowering the pans, and stirring devices driven by an overhead shaft.

MOULDING CHOCOLATES. *L. R. Levy*. 151,329 (25,306). October 15th, 1919.

In a machine for settling chocolates or similar products in moulds, the table has imparted to it a violent shock, followed by a series of lesser ones.

PRESSES FOR EXTRACTING LIQUIDS (FROM BEET MASS, ETC.). *N. T. Thaberg*, of Malmo, Sweden. 151,907 (10,565). April 20th, 1920.

A press for treating "beet mass," peat, etc., has a straining surface comprising a plurality of plates or lamels arranged edgeways, side-by-side, and mounted on links that form an endless chain driven by means of sprocket wheels, rollers or the like.

EXTRUSION MACHINE FOR USE IN CONFECTIONERY MANUFACTURE. *W. B. Laskey*, of Brooklyn, New York, U.S.A. 151,940 (27,918). October 1st, 1920; convention date, April 18th, 1917; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

HEAT EXCHANGERS. *Aktieselskapet de Norske Saltverke*, of Bergen, Norway. 151,943 (27,931). October 1st, 1920; convention date; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Tubes of heat exchangers are made with one or more shallow helical grooves, which may be continuous, the purpose of this construction being to impart a rotary movement to the liquid passing through them.

MIXING FRUIT JUICES WITH STARCH (GLUCOSE. *Merrell-Soule Co.*, of Syracuse, New York, U.S.A. 151,965 (16,570). June 18th, 1920; convention date, October 2nd, 1919; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

The juice of such fruits as pineapples, loganberries, grapes, raspberries, or strawberries, but more particularly oranges and lemons, is mixed with a product obtained by the hydrolysis of starch (preferably containing less than 22 per cent. of dextrose and about 50 per cent. of dextrin), and evaporated to dryness, an apparatus for carrying out this last operation in which the liquid is sprayed into a chamber containing hot air, being described.

COLUMN STILL OR RECTIFIERS. *Barbet et Fils et Cie.*, of Paris, France 151,988 (27,639). September 29th, 1920; convention date, October 1st, 1919; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

The plates of a column still or rectifier are formed with transverse ridges between the openings for the passage of the vapours. Transverse hoods which cover the openings carry perforated plates, which rest on ridges and when in position form a horizontal perforated surface. When the pressure in the still falls, liquid passes through the perforations into the depressions between the ridges. A cooling coil may pass between the hoods and be attached to the perforated plates.

Sugar Crops of the World, 1911-12 to 1920-21.

Messrs. Willett & Gray's Figures.

In a recent issue of their well-known *Weekly Statistical Sugar Trade Journal* Messrs. WILLETT & GRAY give the figures of the sugar crops of the world for the last nine years plus their latest estimate of the present season. These figures have appeared in our pages at one time or other during the past decade, but we give below the principal totals grouped together for convenience's sake. It may be observed that the more recent estimates of the crops of the war years give slightly divergent figures from those published earlier; but this has been inevitable as more complete details have come to hand.

	CANE CROPS.		BEET CROPS.		WORLD'S TOTAL CANE AND BEET.
	TOTAL IN AMERICA.	WORLD'S TOTAL.	TOTAL IN EUROPE	WORLD'S TOTAL.	
1911-12 ..	4,297,973 ..	9,175,130 ..	6,338,638 ..	6,889,261 ..	16,064,391
1912-13 ..	4,422,611 ..	9,289,583 ..	8,317,637 ..	8,963,652 ..	18,243,235
1913-14 ..	5,001,097 ..	9,801,536 ..	7,962,364 ..	8,629,337 ..	18,430,873
1914-15 ..	5,107,717 ..	10,176,649 ..	7,661,613 ..	8,321,849 ..	18,498,498
1915-16 ..	5,314,238 ..	10,628,248 ..	5,542,358 ..	6,339,755 ..	16,968,003
1916-17 ..	5,537,185 ..	11,336,664 ..	5,013,087 ..	5,760,164 ..	17,096,828
1917-18 ..	5,802,246 ..	12,412,456 ..	4,316,016 ..	5,010,133 ..	17,422,589
1918-19 ..	6,383,482 ..	11,977,885 ..	3,183,188 ..	3,880,380 ..	15,858,265
1919-20 ..	6,288,135 ..	11,949,747 ..	2,603,480 ..	3,272,937 ..	15,222,684
1920-21 ..	6,714,138 ..	12,689,138 ..	3,648,372 ..	4,613,372 ..	17,302,510

Brevities.

It is of interest for the chemist to notice that I. M. KOLTHOFF¹ points out that the adsorbing action of filter paper, at least so far as electrolytes are concerned, is to be ascribed to its ash content, which functions as a calcium-permutite, in which the calcium ion may be replaced by another positive ion, which thus becomes fixed by the paper.

Maple sugar production has increased considerably during recent years. In Quebec it was 13,393 tons during 1920, as compared with 4911 tons in 1911. In Ontario the output is now 3125; while in Novo Scotia and New Brunswick, the only two other provinces in Canada in which this sugar is manufactured, the amount is only about 223 tons.²

TH. PAUL³ has recently shown that the sweetness of saccharin and its compounds is dependent upon the concentration of the solution tested. Thus the sweetness of the hydrated sodium salt, in concentrations varying from 2 to 10 per cent. was found to vary between 200 and 700 times that of sugar, and not to be 420 times that of sugar, as is generally accepted.

We regret to record the death on January 15th of Mr. CHARLES SIMMONDS, the author of the excellent work entitled "Alcohol: its Production, Properties, Chemistry, and Industrial Applications," which was appreciatively reviewed in this *Journal* last year.⁴ Mr. SIMMONDS was a chemist of wide experience, and had served in the Government Laboratory, London, where he was recently promoted to the grade of Superintending Analyst.

The problem of the cause and prevention of the deterioration of sugar has been taken up in Mauritius,⁵ and a special report will later be issued discussing the results obtained. While it is recognized that micro-organisms are actually responsible for the changes effected, emphasis is laid on the predisposing cause, which depends on the existence of special factors, such as the moisture content of the surrounding air, the pressure exerted on the sugar during storage, etc.

The Manbré Saccharine Co. (previous to the formation of the new company, the Manbré Sugar and Malt Co.) had a capital of £250,000, and in the last year of its existence made the modest trading profit of £17,700. The profits of the new concern for the year ending September 30th last amounted, however, to £220,200, but the nominal capital now stands at £750,000, the further acquisition of the Brewers' Sugar Co., of Greenock, having entailed another expansion. A dividend of 16 per cent. on the ordinary shares is now declared, while the deferred shareholders receive a distribution amounting approximately to 50 per cent.

A comprehensive scheme for the organization of research has been drawn up by the Institute of Brewing.⁶ Investigations on the breeding and cultivation of hops will be undertaken at the South-Eastern Agricultural College at Wye and at the Malling Fruit Research Station. Prof. F. L. PYMAN, at the Manchester College of Technology, will take up the matter of examining those constituents of the hop which determine its preservative and antiseptic properties; while Prof. F. B. SCHRYVER and Prof. P. GROOM, at the Imperial College, South Kensington, will attack the problem of the suitability of various species of oak for cask-making.

The following are the names of the officers elected and committees appointed to the Hawaiian Chemists' Association, at the annual meeting held in November, 1920; President, F. T. DILLINGHAM; Vice-President, W. R. McALLER; Secretary-Treasurer, S. S. PECK; Executive Committee, H. L. WHITE, Hawaii, J. P. FOSTER, Maui, D. W. RICHARDSON, Kauai, G. R. STEWART, Oahu, J. A. VERRER, Oahu, W. F. VAN H. DUKER, Oahu; Committee on Boiling-House Methods, HORACE JOHNSON; Revision of Methods, W. R. McALLER; Mill Equipment, W. F. VAN H. DUKER; Indicating and Recording Instruments, J. P. FOSTER; Cane Deterioration, B. B. HENDERSON; Juice Deterioration, G. H. HALDEN; Seed and Seed Preparation, J. A. VERRER; Agricultural and General Topics, G. R. STEWART.

¹ *Pharm. Weekblad*, 1920, **57**, 1510-1529.

² *J. Soc. Chem. Ind.*, 1921, **40**, No. 2, 30 R.

³ *Schweiz. Chem.-Z.*, Nov. 30th, 1920; through *J. Soc. Chem. Ind.*, 1920, **40**, No. 2, 33 R.

⁴ *I.S.J.*, 1920, 103.

⁵ Cf. also the work of BROWNE, OWEN, KOPELOFF, and others, *I.S.J.*, 1918, 228, 265, 319, 370, 543; 1919, 277, 334, 466; 1920, 282, 523, 591.

⁶ *J. Fed. Inst. Brewing*, 1921, **21**, No. 1, 1-5.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR. IMPORTS.

	ONE MONTH ENDING JANUARY 31ST.			
	QUANTITIES.		VALUE.	
UNREFINED SUGARS.	1920. Tons.	1921. Tons.	1920. £	1921. £
Germany .....	....	....	....	....
Netherlands .....	....	....	....	....
Belgium .....	....	....	....	....
France .....	....	....	....	....
Czecho-Slovakia .....	....	....	....	....
Java	375	16,487	25,239	522,7 8
Philippine Islands .....	....	....	....	....
Cuba	27,111	....	842,699	....
Dutch Guiana .....	....	72	....	2,665
Haiti and San Domingo ..	....	....	....	....
Mexico .....	....	....	....	....
Peru	10,401	8,658	368,766	251,519
Brazil	1,333	9,087	70,420	259,072
Mauritius	11,802	21,549	610,104	666,477
British India	994	....	46,610	....
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	4,175	12,016	280,078	392,696
Other Countries	874	8,968	60,159	282,262
Total Raw Sugars	57,066	76,838	2,304,075	2,377,459
REFINED SUGARS.	1920. Tons.	1921. Tons.	1920. £	1921. £
Germany	125	....	9,455	16
Netherlands	960	....	41,567	14
Belgium	78	20	6,570	865
France	1	1	18	26
Czecho-Slovakia	19	....	1,329	....
Java	4,999	3	322,172	147
United States of America ..	32,545	8	1,318,023	413
Argentine Republic .....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	2,717	143	216,264	6,697
Total Refined Sugars ..	41,445	175	1,915,396	8 178
Molasses	6,928	8,869	261,862	42,247
Total Imports	105,439	80,882	4,481,333	2,420,884

EXPORTS.

BRITISH REFINED SUGARS.	1920. Tons.	1921. Tons.	1920. £	1921. £
Denmark .....	....	....	....	....
Netherlands	1	89	49	3,342
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	25	115	1,363	6,100
Canada .....	....	....	....	....
Other Countries	4	162	242	7,128
Total British Refined Sugars	30	366	1,644	16,570
FOREIGN & COLONIAL SUGARS				
Refined and Candy	230	5	11,422	442
Unrefined	1,223	480	75,134	16,151
Various Mixed in Bond .....	....	....	....	....
Molasses	387	51	7,669	895
Total Exports	1,870	902	95,869	34,058

Weights calculated to the nearest ton.

United States.

(Willott & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920 Tons.
Total Receipts January 1st to 20th		34,512 ..	113,750
Deliveries		36,418 ..	113,750
Meltings by Refiners		39,973 ..	86,551
Exports of Refined		— ..	—
Importers' Stocks, January 19th		9,146 ..	—
Total Stocks, January 19th		53,227 ..	25,182
		1920.	1919.
Total Consumption for twelve months		4,084,672 ..	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1917-1918, 1918-1919, AND 1919-1920.

	(Tons of 2,240 lbs.)	1917-18 Tons.	1918-19. Tons.	1919-20. Tons.
Exports		3,210,754 ..	3,825,239 ..	3,363,773
Stocks		63,116 ..	— ..	192,471
		3,273,870	3,825,239	3,556,244
Invisible Supplies		32,875 ..	— ..	53,833
Local Consumption		130,338 ..	146,537 ..	120,000
Destroyed by Incendiarism		9,000 ..	— ..	—
Total Production		3,446,083 ..	3,971,776 ..	3,730,077

Havana, December 29th, 1920

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR ONE MONTH ENDING JANUARY 31ST, 1913, 1920, AND 1921.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	78,597 ..	41,445 ..	175 ..	78 ..	230 ..	5
Raw	77,941 ..	57,066 ..	76,838 ..	234 ..	1,223 ..	480
Molasses	8,350 ..	6,928 ..	3,869 ..	61 ..	387 ..	51
	<u>164,888</u>	<u>105,439</u>	<u>80,882</u>	<u>373</u>	<u>1,840</u>	<u>536</u>
	HOME CONSUMPTION.					
	1913. Tons.	1920. Tons.	1921. Tons.			
Refined	74,503 ..	31,810 ..	875 ..			
Refined (in Bond) in the United Kingdom	59,431 ..	57,451 ..	77,708 ..			
Raw	9,479 ..	22,732 ..	12,407 ..			
Molasses	3,019 ..	5,047 ..	1,366 ..			
Molasses, manufactured (in Bond) in United Kingdom ..	3,813 ..	6,374 ..	3,167 ..			
Total	149,745	123,414	95,523			
Less Exports of British Refined	2,109	30	366			
	<u>147,636</u>	<u>123,384</u>	<u>95,157</u>			

Sugar Market Report.

Our last report was dated 8th January, 1921.

There is no change to record in official prices, which stand at 72s. per cwt. for Granulated, Crushed and White Pieces, and 76s. per cwt. for Cubes, duty-paid spot terms. The Ministry of Food announces the next date for revision of prices as 21st February, and states that no alteration will be made in the meantime. The anticipated decontrol of sugar is a much discussed topic, general opinion leaning in favour of an early announcement being made. Further business has been done in sugars to arrive, mostly to manufacturers, including a few thousand tons of Czecho-Slovak Superior Granulated at about 38s. to 38s. 6d. f.o.b. Hamburg, for near delivery. The demand appears satisfied for the time being, and offers of Czecho-Slovak, Dutch, and American Granulated at less money fail to tempt buyers further.

The spot market has ruled steady, with a moderate enquiry. W.I. Crystallized, which sold up to 66s. per cwt., for grocery lots, is now quoted at 62s. to 64s. 6d. according to quality. Muscovados and Syrups have been more saleable, and value approximately 38s. for low, 45s. for medium, and 50s. for fine descriptions. Peruvian 96 per cent. Centrifugals are quoted at 22s. per cwt., f.o.b. for February/March shipment.

The consumption in the United States for the year 1920, according to Messrs. WILLETT & GRAY, amounted to 4,084,672 tons, against 4,067,671 tons in the previous year, or an increase of 17,001 tons. It is interesting to note that the quantities of Foreign sugar consumed, on which the full duty was assessed, were 554,019 tons in 1920 against 57,738 tons in 1919 and 19,303 tons in 1918, although Messrs. WILLETT & GRAY point out that the total quantity of full duty sugars imported in 1920 was much larger than the figure named. The plentiful stocks with which the U.S. started the present year, and the prospective supplies, combined with a lower range of prices and the bareness of invisible stocks, should favour a more substantial increase in consumption during the present year, and certainly afford more solid ground than existed a year ago upon which to base such expectations.

The Cuban crop is progressing slowly, total receipts to 22nd January being fully 400,000 tons less than at the same date last year, so that ideas of the crop have been modified, and some people talk of no more than 3,500,000 tons. A considerable amount of business has been transacted: Japan is said to have bought 25,000 tons Centrifugals, and it is reported that the British Royal Commission has purchased 100,000 tons at 4 cents per lb. f.o.b. An extension of the moratorium in Cuba however was followed by a further decline, to-day's quotation for 96 per cent. Centrifugals being 3.30 cents per lb. f.o.b.

The position in Java has been favoured by a revival in the demand from Far Eastern Countries, which has assisted the marketing of considerable quantities. Japan has been a buyer, her purchases including 50,000 tons Muscovados. For India there is a good demand for ready and near parcels, but buyers hesitate to pay the prices asked by first-hand sellers for forward deliveries. The present quotation for Calcutta is 40s. per cwt., cost and freight. During the past month the price for White Javas f.o.b. marked an advance to 30 guilders per picul (say, 46s. per cwt.), and after a sharp reaction, has recovered to 24½ guilders (37s. 9d. per cwt.). New Crop is quoted at 20½ guilders (30s. 9d. per cwt.), June/July shipment, sellers. There are enquiries for White Javas for Mediterranean destinations, but sellers are not anxious to offer, and essential credits for the business are not always forthcoming. The nominal quotation is 41s. per cwt. c.i.f.

Latest reports from Czecho-Slovakia put the present crop at 620,000 tons, of which 320,000 tons is required for home consumption, and about 100,000 tons will go to Switzerland and German-Austria, leaving about 200,000 tons for export. Nothing further has transpired regarding the negotiations for the sale of half this quantity to France.

Generally, the outlook appears more hopeful; the article has reached a low price, and financial conditions are shaping towards improvement, whilst supplies are such as to allow scope for possible increases in consumption.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
7th February, 1921.

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NOTE The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Royal Commission: the End of its Control.

A month sooner than was generally expected, the Royal Commission on the Sugar Supply of the United Kingdom terminated its labours on February 26th, and thereafter the British sugar market was freed from all official control. The State regulation of the sugar supply arising out of the war was put in force in August, 1914, and has continued ever since till the end of February, 1921. That official control was necessary at the outset was apparent when it was considered that two-thirds of our sugar supply at the time came from enemy countries; the consequential quest for a substitute to be gleaned from all corners of the earth was clearly a task, in the existing dislocation of the financial market, that called for immense resources, and it was too much to expect that it could be left to private enterprise without endangering the consumer's interest. *A priori*, the Commission was justified; if it acted, to start with, in a panicky fashion and bought an excessive amount of sugar at the top of the market (as we had occasion to complain in our pages¹ in 1915), that was mainly the fault of the *personnel* of the Commission which was composed largely of Government politicians of the day. After the first 12 or 18 months most of these politicians retired and their places were filled by business men, after which less was heard of criticism and it was generally agreed that, taking their operations as a whole, the Royal Commission abundantly justified its existence. It certainly minimized fluctuations of price, for if sugar was latterly never as cheap in the United Kingdom as in America (e.g., in the latter half of 1920) it was correspondingly true that the consumer over here was never called on to pay the top price that the American public paid in the first half of that same year. In conjunction with the American Sugar Equalization Board, the Royal Commission did useful work in 1918 and 1919 in buying up the existing sources of sugar supply and dividing the sugar between the Allies in Europe and the American public. Unfortunately, the belief in this country that the American Board would continue its labours during 1920 proved unfounded; actually the American market was freed 14 months ago, and the dissolution of partnership between the two biggest buyers of world sugar necessarily added to the difficulties

¹ *I.S.J.*, 1915, 446-449.

of the Royal Commission's operations since during 1920 it had to limit its purchases to less than the quantity that this country could reasonably consume, and leave the United States to buy the lion's share at a lion's price. We question whether America has not paid very heavily for its decision in December, 1919, to withdraw from State control. Had the Equalization Board continued during 1920, we suggest the price of Cuban sugar would never have gone up to 23½ cents and then have dropped in panic fashion and embarrassed if not ruined countless business firms in the States and elsewhere. However 1920 was a graphic illustration of what might have happened in this country if the Royal Commission had not all along held tight hold of the reins; and while they could not please everybody (the sugared goods trade in particular) they did achieve the task of keeping our refineries supplied pretty regularly with 20,000 tons per week all through the trying years of the war and its aftermath; and the public were never really starved of sugar, though their ration was meagre enough in 1918 and the first half of 1920. The chief criticism during the closing months of the Commission's activities was that it had bought 200,000 tons of Mauritius crystals at £90 per ton just before the slump in prices came last summer; but it is a legitimate defence that but for this purchase that crop would have been sold elsewhere and the Royal Commission would have been a buyer for the same amount on the Cuban-American market, in which case the slump would most probably have been postponed if not greatly lessened in intensity when it did come. Moreover, this criticism savoured of being wise after the event; it was the case that sugar expert opinion everywhere was misled as to the probable course of prices, and we were not the only party to assume that the American consumption would maintain itself and therefore the high prices.

Negotiations have been in progress since last December between the Royal Commission and the refiners as to the terms on which the latter were to take over the Commission's remaining stocks of sugar. This, we gather, has been settled to the satisfaction of the refiners, who are understood to have bought the sugar at a price which will leave them in a reasonable position to compete with free sugar during the next few months. Actually they are believed to have enough raw cane sugar to last till August, and what other sugar is in demand in this country in the meanwhile will probably be beet (of which there is a certain amount offering from Czecho-Slovakia) to meet the needs of the confectioners who are said to be firmly in favour of beet sugar owing to its making a more solid confection than cane sugars with their trace of gummy matters have succeeded in doing. There would not therefore appear to be any great opening in our newly freed market for cane sugar for some months to come unless prices are tempting. This will be in part due to the fact that though sugar rationing is a thing of the past, the ration as last fixed was found on the average to represent the present consuming capacity of the country. With unemployment so widespread this winter in the United Kingdom, with food still so dear, and with taxation so heavy, there is correspondingly less inducement to buy a pre-war per capita supply at about four times the pre-war price. Unless then the price is considerably lowered, the 1921 consumption will not very greatly exceed the 1920 one, and present indications do not suggest that it will attain to the 1919 one of a round 1,600,000 tons. A certain amount of cut-price competition by some big retailers has followed the freeing of the sugar market, and sugar in such cases has been sold as low as 6d. per lb. for Granulated. But this practice is hardly likely to be widespread or prolonged, and the ruling prices during the first free week have been: Cubes, 9d.; Granulated, 8d.; Yellow Crystals, 7d.

The Economic Influence on Sugar Prices.

In this respect, the fact must not be lost sight of that the economic conditions which govern the production of sugar will on the average preclude any marked drop in the price of sugar, once the era of speculation is over and the markets revert to a steady business based on the cost of production. As has been pointed out by an evidently well-informed writer in the Glasgow press on the subject, not only have the expenses of production of the raw material increased but also the cost of transport and refining as compared with the pre-war figure, while the present duty on sugar in this country (which we do not expect to be reduced unless for frankly political motives) is 2½d. per lb. Moreover, the retailer now expects to get about 1½d. for his outlays, so the price of sugar landed in this country has to be increased by 4d. per lb. for the above two items only. Another writer gives the following figures for a sugar sold at a United States port at, say, 8 cents: Cost, at 3·75 exchange, 5·12d.; freight, insurance and charges, 0·55d.; landing charges, 0·12d.; import duty, 2·75d.; total, 8·54d., or quite 8½d. per lb. If we allow 1½d. for the subsequent cost of inland transport and distribution and the retailer's profit, we arrive at 10d. per lb., which means, as was pointed out officially in the press last year, that it costs about 5d. per lb. to bring sugar from the American port, where it is purchased, to the grocer's counter. In view of these figures, it is manifest that so long as transport costs remain so high, it is futile to look for any great reduction in the present retail price of sugar in this country, though temporarily consumers may benefit from cut-price competition to sell stocks that must be realized anyhow.

Economic and other Problems in Queensland.

Last year we discussed¹ rather fully the somewhat peculiar local conditions of the Queensland sugar cane industry. Attention was drawn to the fact that, for some reason, sugar has always, in preference to other staples, been subjected to political interference; and that this interference has perhaps been more conspicuous in the great English speaking countries. In the United States, South Africa and Australia, where a small portion only is capable of growing tropical crops such as sugar, and the great masses of population inhabit a temperate climate, a constant struggle has been maintained, on the one hand, by the bulk of the population for cheap sugar and, on the other hand, by the cane growers for a living wage. The narrow belt of coastal land where sugar cane can be grown in Australia is nearly 2000 miles in length, and we pointed out that, naturally, the climatal conditions varied greatly in this tract. Towards the south, where the industry was first established, frosts are not infrequent and there is always the danger of drought, while in the north, frosts are absent and the rainfall is adequate if not sometimes excessive. The resulting tendency of a movement of the whole industry northward was emphasized. But the English field workers are little able to replace the expelled Kanakas, and it is not unnatural that the Mediterranean races have come in to a rather alarming extent; it was pointed out that the alien labour in the northern canefields was estimated at 75-90 per cent., the greater proportion being Italians, who are eager buyers of the cane farms themselves.

Having drawn the attention of our readers to these points, it is hoped that the long, detailed statement by Mr. T. D. CHATAWAY, an ex-Senator of Queensland, printed elsewhere in our columns, will be read with interest. Mr. CHATAWAY is an optimist as regards the future of the Queensland sugar industry, and this is especially permissible now that, in the long struggle, the cane producers have at last scored a triumph, in obtaining a considerable enhancement in the

¹ *I.S.J.*, 1920, page 219.

price to be paid by the Commonwealth for their sugar. What the result of the present alarming slump will be cannot be predicted but, for the present, the industry may be regarded as safe. If all of Mr. Chataway's suggestions mature, there is a rosy future for the industry. Whether the country can join the ranks of exporters, as he prophesies, opens up a new phase in the question on which it is not safe to generalize; but, with the return to normal conditions, the necessarily high cost of white labour will tell somewhat heavily in the account. To obtain such a result, he is right in maintaining that the greatest attention should be paid to economy in working, organizing the industry and pushing on the elaboration of waste products. He suggests that in the future the bagasse may possibly be replaced by petroleum and thus be made available for paper making. Then he presses for the introduction of mechanical cane cutters and suggests that the canes with their tops should if possible be transferred bodily to the mills, where the tops, at present largely wasted, may be made into fuel alcohol. But we do not quite think that his analogy with the rice machinery in California (*sic*) is altogether valid. The permanent difficulty in introducing machinery used in rice fields in the southern United States into the east is to be found in the fact that the cultivation is fundamentally different. No rice fields in Asia could give the firm ground at harvest for such machinery to stand upon; whereas, along the Mississippi, the water is much more sparingly used and the fields are practically dry when the crop is reaped. As might be expected, the question of the increasing concentration of the sugar industry in the north receives considerable attention, together with the greatly increased proportion of alien workers. Mr. CHATAWAY is equal to the occasion, with an interesting suggestion namely, that the homes of the English workers should be on the neighbouring heights, where their wives and children could live in health and comfort, while the labourers themselves could obtain a quick and constant relief from the heat of the plains. The idea is alluring but, to anyone accustomed to British colonies where hill stations are necessary, it merely adds another argument in favour of the Latin and other races who can work without this additional expense, and if the suggested hill gardens are a success, it will not be long before their owners withdraw altogether from the plains. The paper is of extraordinary interest and has that supreme advantage which unhappily we do not possess, the personal touch. It should be read carefully by all who have the interests of Empire sugar growing at heart, as the arguments advanced for many of the ideas are applicable to other countries as well as Queensland.

Refined Sugar to be produced in Cuba.

In a past number of this journal, mention was made of the fact that several sugar factories in Cuba were to turn out a white, or near white, sugar for direct consumption. The process to be generally adopted was the "double sulphitation" one, which when well and cleanly handled makes an excellent white sugar for table use. We are now able to state that in addition a completely equipped refinery on one large plantation in the western part of the island will very soon be turning out refined sugar direct from the cane. This refinery is fully equipped with char (vegetable carbon) filters, revivifying kilns, evaporators, pans, centrifugals, tanks, dryers, mixers, weighing machines, etc.; in fact, everything that a modern refinery needs to have. The machinery is all new and by first-class makers. Most of it was made in the U.S.A., but we are glad to find installed a set of centrifugals made in Scotland. Money has not been spared on this installation, and there is every reason to suppose that it will prove successful.

¹ I.S.J., 1920, 21.

Notes and Comments.

Not only will this refinery turn the output of its raw sugar factory into refined, but also, raw sugars from other factories will be melted and refined there. The output will be 2000 barrels of 250 lbs. each daily (250 short tons). Considerable interest is being taken in this enterprise, and on its success will depend the installation of other such refineries at other factories in the island; any such extension would tend to strengthen still further the position of Cuba as a sugar producer, since the Cubans would be to a greater degree than ever comparatively independent of the U.S.A. and other refiners and be free to enter the world's markets with any class of sugar.

The Financial Crisis in Cuba: The Efforts at Solution.

While on the subject of Cuban affairs, it may not be out of place to quote the following extracts from an account of the Cuban Industrial Situation which the Canadian Government Trade Commissioner at Havana sent home to Ottawa last December; after recounting the causes that lead to the crisis, he summed up as follows the financial position as it existed last December, and the immediate needs of the Cuban industry:—

“The Cuban sugar industry must have large credits at once, and the Island Republic is looking to the United States to supply the necessary funds to enable the sugar industry to get under way. Loans are being made to some centrals, but the amounts are small compared with what is required. It is estimated that to alleviate the situation, Cuba requires a 100 million dollar loan at once. Some of the foremost financial experts of the United States have come to Cuba during the moratorium with the object of arriving at some solution of Cuba's financial problem. Many reports of loans by the United States Government and by American banks have been circulated and published, but as yet nothing definite has been accomplished. The Cuban Government itself is not in a position to advance any large sums of money, as it is said that the Treasury is in a rather depleted condition. The main stumbling blocks to an immediate solution are said to be the very serious situation two or three of the largest Cuban banks were found to be in by American financiers, and the insistence on the part of certain influential Cuban interests that these insolvent banks be propped up rather than be allowed to go into actual bankruptcy with the inevitable losses to thousands of Cuban depositors, to say nothing of the shareholders.

“Meanwhile it is probable that the moratorium will be extended, with, possibly, provisions for its gradual removal by an ascending scale from 10 per cent. per month until Cuba receives payment for her forthcoming sugar crop. This means that the debts of Cuban merchants to their foreign creditors will be gradually liquidated just as the gradual lifting of the moratorium will force liquidation amongst the Cubans themselves. It is quite possible, too, that United States interests will float a Government loan of some 50 million dollars.

“Cuba is now able to produce so much sugar that her present difficult situation must be only a temporary if painful phase of world deflation. As pointed out previously in this article, the world's present sugar production is some 2,000,000 tons below pre-war production, while the demand for sugar, especially in North America, where Cuba markets the most of her crop, has increased. The recent high sugar prices have enabled the sugar industry in Cuba to put more of the rich island soil under cane and to construct many of the most modern and efficient sugar mills in the world, producing a very high-class grade of sugar. If sugar goes no higher than its present price in Cuba of around 4 cents, Cuba's proceeds from the forthcoming crop of 3,700,000 tons (estimate) will be some 330 million dollars U.S. currency. Even at 3 cents, the normal pre-war price, the crop would be worth

some 250 million dollars. Cuba has enjoyed for many years a visible favourable balance of trade, in that her yearly exports have exceeded in value her imports. In 1919, for example, the value of her exports was \$571,536,191, and of her imports \$354,890,000—leaving a favourable balance of trade of \$216,646,109—a tremendous sum for a small country of less than 3,000,000 people."

Development Prospects in Natal: The Need for New Machinery.

A writer in the *British and South African Export Gazette*, who appears to have made a special study of the subject, states that while the South African sugar producers maintain the belief that 1921 is going to be a boom year for them, the milling side of the industry has considerable arrears to make up ere the promise is certain of performance. The existing mills, he avers, are not able to cope with even the present crop levels of between 150,000 and 180,000 tons, while the existing refineries can only deal with half the production of the mills. Yet there is plenty of room for development, for there are still more than 65,000 acres of proved sugar lands in Zululand and some 54,000 acres in Natal proper, waiting to be cultivated. The chief cry to-day is therefore for more machinery.

Already some valuable contracts are definitely in prospect, but there are many more to follow, as not only are there new schemes on the tapis—e.g., that of the Uba Co-operative Sugar Milling Co., which proposes to spend £420,000 on sugar machinery and equipment—but it is perfectly clear that the existing installations must inevitably enter on an active policy of re-equipment without delay. "Visits to a large proportion of the 30 or more mills now in operation produced the impression that they could not much longer maintain what appeared to be the present procedure of largely living on each other's second-hand and discarded machinery. That procedure is the natural outcome of the conditions which, under Government control and interference during and since the war, have discouraged bold enterprise, but it cannot be continued. The need for renewals and extensions has become urgent, and already a lead has been given by those pioneers of the industry, Sir J. L. Hulett & Sons, Ltd., in deciding to increase the equipment of their Felixton and Amatikulu mills. The scope for such extensions and additions is undoubtedly very wide, and at some period in the near future every millowner in the country will be in the market for equipment of one kind or other."

Assistance for Patentees.

The Department of Scientific and Industrial Research in the United Kingdom has lately appointed an Inter-Departmental Committee on Patents, under the chairmanship of Mr. KENNETH LEE, LL.D., with a view to considering methods of dealing with inventions made by workers aided or maintained from public funds, whether such workers be engaged (a) as research workers, or (b) in some other technical capacity, so as to give a fair reward to the inventor and thus encourage further effort, to secure the utilization in industry of suitable inventions and to protect the national interest; and also to outline a course of procedure in respect to inventions arising out of State-aided or supported work, which shall further these aims and be suitable for adoption by all Government Departments concerned.

This committee will consist, as at present arranged, of 16 members composed of experts in various scientific and industrial spheres: the Secretary to the committee is Mr. A. ABBOTT, to whom all communications should be addressed at 16 and 18, Old Queen Street, Westminster, London, S.W.1.

Fifty Years Ago.

From the "Sugar Cane," March, 1871.

"J.S." of Trelawny, Jamaica, contributes in this issue a rather long article on the manufacture of rum, from which, in order to expose the opinion prevailing at that time on this subject, it may be of some interest to extract a few remarks. "Notwithstanding the superior character of Jamaica rum in general, there arise the most baffling dissimilarities in the *flavour* and value of rum made even on neighbouring estates, the price realized for one being sometimes double that of the other . . . Pursuing the course indicated by the fact of the better rum being produced by slow fermentation, this direction has been followed to the utmost limit consistent with a reasonable sacrifice of quantity and quality . . . Were the result attending this rather hazardous experiment always a success, we might be content to abide by the conclusion that this aroma is entirely the effect of a certain process of fermentation; but as such fails to be the fact the more natural supposition seems to be that it is a peculiarity incidental to certain soils . . . Skimmings communicate in a far greater degree than molasses the characteristic stamp to rum. A spirit made of pure molasses and water would scarcely be rum; and instances are familiar of molasses having been removed from one place and distilled at another, which with different skimmings have produced an entirely different rum . . ." In conclusion, it was mentioned that at that time ordinary rum was netting £15 per puncheon, and the best class of brands £18 and even £25, sugar manufacture being quite a secondary consideration on the estates where such lucrative products were made.

There was only one other contribution to which it is worth while now directing attention, the rest of the contents of this issue being mainly of ephemeral interest. This was by Prof. CHARLES A. JOY. He presented a very fair account of the information available at that time regarding the manufacture of starch glucose. Indeed, his clear description might still be read in order to obtain a general idea of the process. This writer, however, appears to have fallen into the error of confusing dextrose with invert sugar, inasmuch as he remarked that it is a singular fact that although we can prepare grape sugar from cane by the action of acids, no way is at present known by which glucose can be converted into sucrose, adding optimistically that "it would be a discovery of great importance if we could make cane sugar from glucose, as in that event common sugar could be produced from a great variety of refuse matters, and would be largely reduced in price." It was mentioned that there was a time when much grape sugar was manufactured in England clandestinely for the purpose of adulterating muscovado sugar, which illegitimate business was dissolved on the reduction of the high tariff on this latter commodity. Another fact recorded was that German farmers were in the habit of preparing food for fattening their hogs by digesting the potatoes with their parings, it being found that the starch thus became transformed into glucose. It is now known that this conversion would be effected by means of bacteria present in the soil adhering to the parings, and in passing it may be mentioned that a process for the production of fermentable sugars utilizing this principle was patented quite recently.

In 1870 the consumption of sugar in the United Kingdom was 668,000 tons; in France, 316,000; and in all Europe, 1,334,000 tons. A market report published in this issue stated that the price of lump sugars was about 46s. per cwt.

Notes on American Sugar Production.

(From our American Correspondent.)

The one subject of compelling interest to the sugar trade during the past week has been the appointment in Cuba of a Sugar Finance Committee to supervise the financing and marketing of the current sugar crop. For some time past discussion of various proposals for stabilizing the market and preventing its undue depression through sales by necessitous producers has been under way. Now it is announced that a commission to accomplish these objects, so far as they may prove attainable, has been appointed by President Menocal. It is composed of four prominent sugar producers, two representatives of important banking institutions, and one representative of the Cuban Government.

It is understood that the project put forward in Cuba, at various times within the past few months, for the laying of an embargo against the export of sugar below a specified price has been abandoned. Instead, it is reported, the question of price has been left to the judgment of the committee who will be governed presumably by market conditions from day to day or week to week.

To uphold the authority of the committee the sale and shipment of sugar from Cuba will be prohibited except at terms and prices which meet with their approval. Another part of the committee's duties, it is reported, will be to aid in the provision of funds for financing the grinding and marketing of the crop, and it is the importance of this phase of the situation presumably which led to the inclusion of prominent bankers in the membership of the Committee. The fact that a number of centrals have been compelled to suspend grinding, according to report, because of lack of funds illustrates the urgency of financial assistance. Various sums ranging from \$25,000,000 to \$75,000,000 (£5,000,000 to £15,000,000) are estimated to be required for the making and marketing of the crop now under way. Probably \$50,000,000 (£10,000,000) would be a reasonable estimate of actual requirements. It is understood that the adoption of the plan was made contingent upon its approval by producers representing 75 per cent. of the Island's production and that approximately this number have given their assent.

While the proposal appears to have the approval of a majority of the Cuban producers, a number of companies, including at least one important American interest, are known to have withheld their approval, apparently through fear that an attempt might be made to raise prices to an artificial level and that such a course might lead to an injurious reaction. It is stated upon good authority, however, that no such effort is contemplated by the Committee which will limit its activities to the necessary financing and orderly marketing of the crop.

Whatever the ultimate effect of the undertaking, the immediate influence of the announcement of the plan at the beginning of the present week was to bring about a sharp rise in prices, 96° test Cuban centrifugals advancing on February 14th from 4 to 5 cents (2d. to 2½d.) per lb. on a cost and freight basis, New York. The latter figure is equivalent to 6.02 cents duty landed. A slight reaction occurred the following day when the price declined to 5.77 cents duty paid or 4.75 cents cost and freight. At this figure the volume of transactions was larger than it had been on any single day for a number of weeks. The advance in raws was reflected by an increase in the wholesale price of refined, practically all refiners advancing their quotations from 6.85 cents to 7.50 cents, although several were forced to withdraw from the market through lack of raw supplies. This was the first time in many months that an advance had taken place in the price of refined sugar.

Notes on American Sugar Production.

With this indication of retaining strength in the market and with demand from the distributing trade and the consuming public showing signs of greater activity, a more optimistic feeling is in evidence in the trade than has been witnessed since the long decline in prices set in, months ago. It is realized by conservative members of the trade that there are adverse factors still to be overcome, but it is generally felt that the worst of the depression is behind.

Another helpful factor in the Cuban situation has been the ending of the moratorium on February 1st, with the enactment of the Torriente law providing for the gradual liquidation of outstanding accounts and the payment of claims by the banks. It is believed that the course now adopted will enable Cuba gradually to work out of her serious financial difficulties and to resume industrial and commercial activities along more conservative lines than were followed heretofore.

The slump in prices and inability to sell sugar have placed a number of sugar companies in the United States in a serious financial predicament. One large beet sugar company was under the necessity of borrowing \$30,000,000 (£6,000,000 at par) in order to make payments to growers for beet roots sliced during the past campaign. Ordinarily, such payments are met from the sale of sugar, but this year the lack of demand made this course impossible. Other companies occupying a weaker credit position have been forced to delay payments and to curtail operations. Practically all the new construction work under way was suspended before the end of the year. All these difficulties, however, are regarded as only temporary, and it is believed that they will be overcome within the next few months, although many beet sugar companies are likely to show a deficit on the year's operations.

Consumption of sugar in the United States during 1920 amounted to 4,101,100 long tons, or approximately 87 lbs. per capita. This was a decrease of slightly over 100,000 tons from 1919. Of the sugar received in 1920 approximately 1,600,000 tons was of domestic production, 2,572,000 tons was supplied by Cuba, and 881,000 tons was from other countries. Exports of refined sugar amounted to 412,500 tons as compared with 660,000 tons the previous year. Stocks on hand at the end of the year, including unsold beet sugar, were roundly 1,000,000 tons, a much larger amount than has been carried over the turn of the year at any previous time since the pre-war period.

New York, February 17th, 1921.

The Financial statement of the Government of India just presented to the Indian Legislative Assembly provides for an increase of duty on foreign sugar of 5 per cent, making the new rate 15 per cent. This is expected to produce 65 lacs of rupees (£650,000, at 10 rupees to the £).

Owing to the withdrawal of Belgium and Holland from the Brussels Sugar Convention, all sugar manufactured in these countries will be subject to a surtax on importation into the Union of South Africa, unless accompanied by a certificate, signed by the proper authority, to the effect that no bounty has been given thereon in the country of production or of manufacture.

The existence of the Cantley beet sugar factory for 1921 has been hanging in the balance, as the directors required a minimum acreage of 5000 as a preliminary to opening the campaign. Up to the middle of February 3700 acres only had been promised by farmers and growers, but strong appeals were made during February to interested parties to make up the balance. As compared with Kelham, which has 3000 acres of its own, the Cantley factory would appear to be entirely dependent on outside growers for its supply of roots.

The Prospects of the Cuban Sugar Crop, 1920-1921.

From our Cuban Correspondent.

At the time of writing, a large number of the mills in Cuba have started upon their 1920-1921 sugar crop. The latest information places the number at 130. Last year at the same date there were 180 mills grinding. These figures show the very late start made on the present crop. The causes leading up to this are several, but the most important one was the financial situation.

During the first half, or more, of last year, sugar was at such a high price, that mill owners and planters immediately set about to extend their factories and fields. Money was easily obtainable for those purposes, and a period of wild expansion took place. For their factories, machinery of all descriptions was ordered, principally from the United States of America; and on the plantations new lands were put under cane. Cane farms changed hands at fabulous prices, and in many instances changed hands two and three times, at increased prices on each sale. As money was easily obtainable in part for such sales, one can easily imagine how the get-rich-quick fever caught landowners and others, and how speculation in cane and cane lands went to a mad extreme. In short, encouraged by the high price of sugar, and the firm belief in certain circles that high prices would continue for a few years, frenzied speculation became the order of the day, and values became inflated to unheard-of figures. During that period farmers were accordingly less interested in the proper cultivation of their cane fields than in the craze for buying and selling land. Hence large areas of cane have been neglected, and naturally short crops will be the result.

All this was smooth sailing while money was plentiful, but with a drop in the price of sugar, the inevitable happened—money became tight. This was immediately followed by the Presidential Decree placing a moratorium on all moneys, bills, commercial papers, etc. This immediately brought about a partial cessation of work, especially so in the cane fields. Mill owners who had been spending heavily now found themselves in a most uncomfortable situation. Machinery invoices were now coming due; freights and customs duties had to be paid, and erecting costs had to be met. The moratorium prohibited the banks from allowing anyone more than 10 per cent. of his funds, and this meant that anyone with a heavy outlay to meet could not meet it at the proper time. A large amount of machinery was late in being despatched from the manufacturers, and this coupled with the great congestion at the ports in Cuba, which caused slow discharging of the steamers (some steamers have been lying here for months unloaded) and a shortage of money to pay for that machinery, pay duties, pay freight on this side, and erect the mills, has been a cause of the late start of many sugar factories. And of the mills that are grinding, the large majority have not yet got into their stride, or in other words they are not working full time, for lack of a plentiful supply of cane.

Due to the low price of sugar, the farmers and cane owners this season offered the cane-cutters a very low price for cutting canes as compared with the price paid at the beginning of last year's crop, less than half in fact. Labour became immediately discouraged, and pointed out that the cost of food stuffs had not gone down, and therefore the reduction in price offered, from their point of view, was unfair and unwarranted.

Such action on the part of the cane growers discouraged the labourers so much that the result to-day is a holding back on the part of the workers from

The Prospects of the Cuban Sugar Crop, 1920-21.

cane cutting operations, with the result that the majority of the mills have not sufficient canes to keep them going full time and at full capacity. Prices since the first contracts have latterly been raised, and the cane supply to the mills is now improving, but it must be remembered that this is taking place late in the season.

The above gives a general idea of the principal causes of the late start of the Cuban sugar crop. There were other adverse factors, but more of a local nature, such as a late rainy season which kept the canes growing and prevented them coming to maturity at the usual time. In such instances the mills delayed starting up at the usual date. Taking all in all, it is clear that the Cuban crop this year is about one month behind last year's. We also see that the factories that are grinding are not yet getting their full daily supply of cane, and on these two points alone the Cuban crop this year will be a long way short of last year's figures.

Looking a little closer into the situation in order to get a good basis on which to form a reliable estimate, it may be noted that the late rainy season continued a little longer than usual, and the weather has not been cold enough for rapid maturity, therefore the sucrose in the cane has not been quite so high as that of last year. This is a condition that may improve quickly, and later on the sucrose in the cane may be higher than that of last year at a given date, but in the meantime we must take the facts as they stand. Again, the deliveries at the sea-ports are about 170,000 tons, and on the same date last year there were about 565,000 tons, making a difference of 395,000 tons. On that date two crops ago the deliveries were over 360,000 tons; so it is evident that the deliveries this year are far short of those of the two previous ones.

We do not know how much of this year's deliveries is a part of last year's crop which was held back in expectation of fabulous prices, but we do know that the crop has started late, that harvesting is going slow, and that the deliveries are nearly 400,000 tons less than those of last year at the same date. From such facts we can only conclude that the prospects for a big crop are entirely lacking: in fact they are discouraging.

The 1919-1920 crop totalled about 3,728,000 tons, and the question that must be asked is: How much more behind last year's figure is the Cuban crop likely to drop? Making a guess, from the facts before us, we might well place the figure at from 50,000 to 100,000 tons. This with the already mentioned 400,000 tons makes a drop of from 450,000 to 500,000 tons as compared with last year's crop, and gives an estimate for the present crop of 3,228,000 to 3,278,000 tons. That is, provided the farmers and cane owners can give the labourers a little more encouragement, and that the rainy season does not begin very early. On the other hand, should the labour element not feel satisfied enough to induce them to exert their full efforts in order to keep the mills running full swing, and should early rains begin, then the total output will be less than the figures just stated.

L. W. BATES,¹ at a recent meeting of the Institute of Petroleum Technologists, said the ingredients composing colloidal fuel are 30 per cent. of fine coal, 10 per cent. of coal tar distillate, and 60 per cent. of mineral oil. Colloidal fuel possesses many advantages over fuel oil or coal alone, two of which are that it possesses more B.T.U. per volume than the constituents separately; and that it has a greater combustion efficiency than ordinary oil. Moreover, the risk of uncontrolled fire is less than in the cases of either oil or coal, and its flames may be quenched by water. It may be used in the ordinary oil burning installations without material modifications, and altogether a very important saving in fuel supplies can be effected by "colloidizing" coals and oils.

¹ *Chemical Trade Journal*, 1920, 67, No. 1748, 669.

The Antigua Central Sugar Factory.

A Survey of Fifteen Years of Work.

The Central Factory at Gunthorpes in Antigua has now completed its term of trial of fifteen years, and an interesting résumé of its progress during that period is given by Sir FRANCIS WATTS in Vol. XVIII, No. 3, of the *West Indian Bulletin*. The effect produced by the successful carrying out of this great financial scheme can, perhaps, be best appreciated by those whose acquaintance with the conditions of the Antigua sugar industry is limited to a period of several years a little over a quarter of a century ago. With a killing competition from beet sugar and a disastrous invasion of the fields by new and mysterious diseases, there appeared then to be little hope for the future: but the sugar industry had so thoroughly rooted itself into the very life of the island, through centuries of experience, that it seemed impossible to make any change, and it has always seemed little short of a miracle that it could ever have recovered. This miracle has however been achieved, and no small part has been played in the revival by the successful inauguration, long and laboriously planned beforehand by Sir FRANCIS WATTS, of a factory which, by the introduction of modern machinery on a large scale, has reduced the costs of production and replaced the many effete small installations which were strangling the tied up and impecunious estates.

The somewhat intricate details of the financial side of this scheme are already well known and were fully analysed in this journal,¹ in reviewing the first ten years' working of the factory. By a mutual arrangement of a group of London merchants and a few enterprising local planters, strongly supported by the Antigua Government, a central factory was erected and commenced working in 1905, with a guaranteed supply of canes for the production of 3000 tons of sugar annually. Within a very short time it was obvious that the scheme was a success and that a further supply of canes could be obtained by which, with enlarged mills, the cost of production could be substantially reduced, and the full installation of a 14-roller mill was set up with a capacity of 10,000 tons of sugar every year. It is only just to point out that in any allocation of praise for the success of the Antigua factory, the initiative of the London merchants cannot be left unnoticed, and the name of the chairman of the Board of Directors, Mr. G. MOODY STUART, must be coupled with that of Sir FRANCIS WATTS, as responsible for the successful carrying out of the scheme. It may indeed be permitted to remark that this gentleman has shown, in his dealings with the West Indian sugar industry, that a true spirit of philanthropy can be combined with strict business acumen, and not only so but that this can be done with great mutual advantage to all parties concerned, from the actual growers of the cane to the financiers responsible for the large sums of money required for the installation. The stipulations made by Government for the generous treatment of the growers of the cane have all along met with the cordial agreement of the London group. A short and yet clear statement has come into our hands, which was made by Mr. MOODY STUART at the 15th Ordinary Meeting of the Antigua Sugar Factory, Ltd., in December, 1919, and, as this statement covers most of the points of the somewhat involved character of the arrangements, its main features are here reproduced.

The Chairman said: Gentlemen, the company has now completed the period of 15 years covered by its agreement with the Government, and it is fitting that we should review its history and progress during the time. The island and, I may add, the shareholders in the company owe a debt of gratitude to three men connected with the Government

¹ *I.S.J.*, 1916, p. 208.

The Antigua Central Sugar Factory.

for the initiation of the scheme which resulted in the incorporation of the company in 1903—viz., Mr. JOSEPH CHAMBERLAIN, Secretary of State for the Colonies at that time; Sir GERALD STRICKLAND, the Governor of the Leeward Islands; and Dr. WATTS, now Sir FRANCIS WATTS, of the Imperial Department of Agriculture. It was Dr. WATTS who first brought forward the proposals for a central factory, and supported them with information as to the work done elsewhere by modern factories and with data which he had accumulated regarding the conditions of sugar cane in Antigua, which made it possible for the Government, owners of plantations, and investors to form a judgment on the proposals. Sir GERALD STRICKLAND, with energy and persistence, surmounted the obstacles which are too often found insurmountable in such a case, and Mr. CHAMBERLAIN, when the proposals came before him, made a modification without which it is doubtful if the undertaking would have proved successful.

The original desire of the planters in Antigua was that the Government should undertake the responsibility for a central factory. Mr. CHAMBERLAIN refused this on the ground that, if they did, they would lose their own money and the planters' money also, but he said if private persons, plantation owners and their friends, chose to venture their money, he would approve of the Government giving a grant in aid to a pioneer factory to show what could be done, so that if that succeeded other factories could follow, established on ordinary business lines. An agreement was accordingly entered into between the Government and this company, and the following is a brief summary of the work undertaken and accomplished under it:—

(a) The Government provided £15,000 and the company £25,000, making a total of £40,000, for the erection of a factory to make 3000 tons of sugar in the season. The factory was duly erected, the actual cost being £45,358, approximately £15 per ton of sugar capacity. It made its first crop in 1905. It has since grown to 10,000 tons sugar capacity, and the total cost to capital account has been £103,229, or £10 6s. per ton. (b) The Government stipulated for fair co-operative terms for the original contracting planters, and that, at the end of 15 years, shares representing half the value of the factory should be made over to these. They have received high prices for their canes, the rate averaging in recent years over 9 per cent. on the f.o.b. price of sugar without any deduction for cost of bags or export taxes, the factory also bearing the cost of transport of canes from the estates. These terms are, I believe, much in excess of what has been paid in any other part of the world, and these planters are now to have their shares, representing £51,615, transferred to them free of charge. This result has come from their being not only contracting planters, but also because of their being placed in the position of shareholders in respect of the £15,000 subscribed by the Government. (c) The Government also stipulated for fair rates for canes from peasant growers, and these have received about double the rates previously ruling. Now that the agreement with the Government under which they worked has terminated, and there is no longer any charge on the company for interest and sinking fund for capital outlay, it is proposed to place them on a higher scale of payment for their canes. (d) The subscribers of the £25,000 have received for the whole period an average of 20 per cent. annually on their capital; they have had their capital repaid in full, and they hold shares representing half the value of the factory, or £51,615, and further they have approximately £18,000 standing to their credit in the company's books. The exact figure cannot be ascertained until the assessment for excess profits duty is made. (e) Another large section of the planting community has also profited by the factory, and the factory has profited by it—namely, the owners of plantations in the surrounding districts who have joined as new contractors. These have been paid on terms which have included sharing in half profits on each year's working account. The prices for their canes have compared favourably with prices paid elsewhere, their average in recent years being equal to over 7 per cent. on the f.o.b. price of sugar, the factory bearing all the charges mentioned above in paragraph "b." These new contractors do not receive shares in the company, but now that the capital outlay has been liquidated, the rate for their canes is to be 5½ per cent. on the price of sugar, plus share in half the profits, which should give them a substantial increase on what they have had hitherto.

It may be pointed out that the Government has also received a good return on its grant of £15,000, for the company's payments here for excess profits duty have amounted to £44,476, and £16,951 in the island in export tax imposed because of the war, say, together, £61,427, and both the home and Colonial Governments have profited also in other ways by the company's work. Mr Chamberlain's desire that the Antigua Sugar Factory should prove a pioneer factory and be followed by others was attained, in the first case by the erection of a factory in St. Kitts seven years later on similar co-operative lines, and since then the factory system has spread in other islands.

The general community in the island has also benefited by the factory. Prior to its erection the salaries of estate managers and overseers were far from adequate, the estate revenues being too small to admit of more being given. But soon after the factory started, substantial increases were given on many estates. Also, the labouring population generally had been in great poverty and distress, but with the coming of the factory there was a complete change, work for all and fair living wages.

The funds which have brought about the above mentioned results have come from the extra sugar produced by the work of the factory, as compared with that of the old muscovado boiling-houses. These boiling-houses in Antigua took at least 15 tons of cane (many of them much more) to make one ton of sugar. The canes delivered to the factory in these 15 years have amounted to 928,791 tons, which in the muscovado boiling-houses (on the 15-ton basis) would have given 61,919 tons sugar. Instead of that these canes in the factory have yielded 100,012 tons sugar. We have thus had 38,093 tons extra sugar, value £431,300 net—that is, after deducting cost of manufacture. It is out of this that the good rates for canes have come to the original and new contracting planters, the good return to shareholders and to the Government, the liquidation of the total cost of the factory, and better pay rendered possible to estate staff and labourers.

The results are due, in the first place, to the sound basis on which the work was planned, and then to the improvement in the quality and the increase in the quantity of the work as the years went on. In its first three years the factory took 10 tons of cane to make one ton of sugar, which was just the rate calculated on in advance. Its work steadily improved, and during the last three years it has taken less than nine tons to the ton of sugar. In the first three years the output averaged 2,737 tons, in the last three years 9,586 tons. The improvement in the work gave us over 10 per cent. more sugar costing nothing, and this, combined with more than trebling the quantity, has changed success into a great success.

Outside testimony is not wanting as to the benefits to the island owing to the change, from the small, detached plantations each provided with a set of old, inefficient machinery adapted for the production of muscovado sugar, to the centralization of the production in factories producing white sugar on a large scale. We have extracted the following passage from the Report of the Royal Commission on Trade Relations between Canada and the West Indies (with Lord Balfour of Burleigh as chairman) published as long ago as 1910: "The Central Factory in Antigua furnishes a striking argument in support of this recommendation. It would be difficult to use exaggerated terms respecting the benefits conferred by this factory on the peasant cultivators of the cane and on the sugar industry generally of Antigua; and we could not fail to observe that recognition of these benefits was universal throughout the Leeward Islands."

To return to Sir Francis Watts's paper, the financial position at the close of the fifteen-year period of the original contracts is shown in a table, and this table together with a study of its features is here reproduced (Table I.).

"It will be seen that the cost of the factory has been substantially increased from time to time. The first material increase took place in 1908; this was due to the addition of a Krujewski crusher to the original six-roller mill, together with some additions to the railway. A further notable increase took place in

The Antigua Central Sugar Factory.

1911 in order to permit of additions to the milling plant, whereby the mills were converted into a 14-roller train; there were also substantial additions to the general plant and to the railway. In this manner the capital invested was brought up to £102,961, increased in 1919 to £103,229, at which figure it stood at the conclusion of the original contracts.

"These substantial additions to capital expenditure were made concurrently with an extension of the company's contracts with planters supplying canes on a profit-sharing basis; a second group of contracting cane suppliers was established, who received payment for their canes on the basis of 5 lbs. of sugar for every 100 lbs. of cane (the original contracting proprietors, it will be remembered, received $4\frac{1}{2}$ lbs.), together with their proportion of the half-profits arising from the year's working of the factory.

TABLE I.

YEAR.	COST OF FACTORY.			DEBENTURE INTEREST.			INTEREST OTHER THAN DEBENTURE			LOSS ON EXCHANGE			PROFITS PAID TO SHAREHOLDERS.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1905 ..	45,358	14	9 ..	1,434	14	6 ..	—	..	..	—	..	..	1,942	10	10
1906 ..	45,358	14	9 ..	1,250	0	0 ..	83	1	1 ..	59	4	3 ..	—	..	..
1907 ..	45,358	14	9 ..	1,250	0	0 ..	—	..	..	121	12	9 ..	3,172	15	4
1908 ..	55,360	6	0 ..	1,238	16	8 ..	238	19	8 ..	180	12	3 ..	7,081	11	2
1909 ..	59,371	4	11 ..	998	19	3 ..	666	5	7 ..	149	1	3 ..	4,133	7	8
1910 ..	59,769	3	8 ..	930	19	9 ..	827	6	3 ..	180	16	8 ..	7,231	7	7
1911 ..	89,260	5	0 ..	1,736	1	5 ..	938	1	3 ..	389	12	4 ..	106	7	8
1912 ..	93,222	3	7 ..	1,843	12	0 ..	797	8	10 ..	298	10	10 ..	7,210	7	5
1913 ..	99,438	9	11 ..	1,631	1	4 ..	999	15	5 ..	483	1	8 ..	1,523	5	6
1914 ..	102,961	4	5 ..	1,447	2	11 ..	1,461	19	0 ..	496	12	8 ..	1,711	15	11
1915 ..	102,961	4	5 ..	1,240	16	9 ..	1,247	12	9 ..	..	..	..	11,072	11	0
1916 ..	102,961	4	5 ..	869	16	4 ..	2,347	1	9 ..	..	..	..	23,069	1	2
1917 ..	102,961	4	5 ..	672	18	1 ..	984	2	10 ..	..	..	..	21,541	1	5
1918 ..	102,961	4	5 ..	445	8	9 ..	1,110	1	6 ..	..	..	..	16,388	19	5
1919 ..	103,229	14	5 ..	195	15	8 ..	4,556	1	7 ..	..	..	..	20,745	9	6
	£17,086			3	5	..	£18,617			2	2	..	£126,930		
													11		

"Special financial arrangements were made whereby new debentures were raised bearing interest at 5 per cent. in order to meet the additional outlay, and a sinking fund was created at a rate calculated to redeem these new debentures simultaneously with the original A debentures.

"All the debentures were paid off during 1919, the year in which the original contracts came to an end, the expenditure having been £103,229 14s. 5d., of which £15,000 was provided by the Government grant, and the sum of £88,229 14s. 5d. has been paid off from the earnings of the undertaking. The factory therefore closes the period of its original contracts with all its debentures and loans paid off, and stands possessed of a modern plant, buildings, and railways which may now be taken to be worth some £200,000. Shares representing one-half of this now pass into the hands of the original contracting proprietors in proportion to the weight of the canes supplied by each during this period."

The author then proceeds to give further details as to the way in which the original contracting proprietors have fared, but unaccountable errors in actual figures as well as in the arrangement of the paragraphs appear to have crept into this part of the paper, making it very difficult to follow. Reference was made to the London Office of the Company and corrected figures are here given as supplied by them. Further, six lines in the middle of page 137 (commencing at "5 per

cent.") appear to have been interpolated in setting up and have nothing to do with the context. Lastly, the last two paragraphs on this page and the first on the next page are repeated on page 140, but are taken as belonging to the former of these two places. With these corrections the paper should read as follows:—

"It will be interesting to see how the original contracting proprietors have fared. During the 15-year period they have supplied 350,126 tons of canes, and have received by way of first payment the sum of £226,610, an average of 12s. 11d. per ton of canes. The sum of £130,779 15s. 9d. has been paid to them as their share of the profits of the factory during this period; this is equivalent to 7s. 6d. per ton of canes supplied. Furthermore, they have now received shares representing one-half of the factory; if the factory is valued at £200,000, one-half of this represents a further payment of 5s. 7d. per ton of canes. The average price paid to the original contracting proprietors for their canes has thus been 20s. 5d. per ton, plus a share in the factory, which may be valued at 5s. 7d. per ton.

"While the amount charged to capital account as the cost of the factory and its railways is £103,229 14s. 5d., the cost of repairs and maintenance has been £97,530 15s. 10d., in respect of the factory, and £38,814 7s. 10d. as regards the railway, exclusive of fuel in each case, a total of £136,345 3s. 8d., equivalent to £1 7s. 3d. per ton of sugar made. If to this is added the sum charged to capital account, the factory has cost, to equip and maintain in its present state of efficiency, £239,571 18s. 1d. It is probable that some amounts charged to repairs and maintenance might in some circumstances have been charged to capital account, still the figures indicate that in the case of a modern and expanding sugar factory very considerable expenditure must be allowed for, in order to meet charges for repairs and maintenance. It is suggested by some authorities that an amount equivalent to £1 per ton of sugar made should be allowed for this purpose, and this may be exceeded while machinery remains at the present high cost. The sum so expended on the Antigua factory is considerably in excess of this amount.

"The financing of the factory has been managed very efficiently, and at low cost: the total amount spent on debenture interest was £17,086 3s. 5d., and on other interest on loans, and loss on exchange, £18,617 2s. 2d., an aggregate expenditure of £35,703 5s. 7d., equivalent to 7s. 1½d. per ton of sugar made. In planning other factories under present conditions more than double that amount might reasonably be allowed.

"The various financial statements plainly indicate the effect of the war upon the sugar industry; while the cost of machinery and the cost of sugar production have greatly increased, the price of sugar has increased in still greater proportion, so that factories are placed in a very favourable financial position. Not only is this the case during the period ending with the year 1919, but this position has become greatly accentuated during 1920. It is to be observed, however, that the Antigua factory was in a sound financial position before the war; it was meeting its liabilities in the manner originally planned, and was rapidly extending its operations. The effect of the changed conditions due to the war was undoubtedly to give rise to a great increase in the factory's profits, and afforded enhanced stability; but it is to be remembered that the shareholders derived comparatively little financial benefit from these increased profits, owing to the fact that, the company being registered in England, the profits of the factory were subject to Imperial Income Tax and to Excess Profits Duty. . . .

"The financial side of the factory itself may now be examined. As already stated, the original expenditure on the factory was £45,358 14s. 9d.; this was

The Antigua Central Sugar Factory.

represented by 12,500 A shares. An equal number of B shares represented the interest in the concern of the original contracting proprietors who supplied the canes. The expenditure on the factory and its railways was subsequently increased up to £103,229 14s. 5d.

"During the 15 years the A shareholders, who were also largely debenture holders, have received interest on their debentures during such time as they were outstanding, at the rate of 5 per cent.; they have also received the sum of £130,779 15s. 9d. as their share of the profits of the factory during the period."

Attention is next drawn to the working of the factory during the fifteen years, and a series of tables are given of which we reproduce the first: the others analyse the detailed expenses incurred, give the number of tons of canes purchased from the various contracting parties and the prices paid for these year by year.

"From Table II it is seen that during the 15 years 928,613 tons of canes were dealt with, and 99,995 tons of sugar produced: this is at the rate of 1 ton of sugar from 9·289 tons of cane; or sugar produced at the rate of 10·77 per cent. of the weight of the cane. The sugar made was ordinary 96° refiners' crystals.

TABLE II.

Year	Total quantity of Canes crushed, tons	Total quantity of Sugar made, tons	Tons of Cane to 1 ton of Sugar.	Commonest Sugar 96° made per 100 of Cane	Cost of Manufacture in terms of Sugar per 100 of Cane	Difference between P.C. Sugar on Cane and Cost of Manufacture in terms of Sugar per 100 of Cane.	Cost of Manufacture per ton of Sugar	Price of Sugar per ton
							£ s d	£ s d
1905 ..	15,681 ..	1,634 ..	9·70 ..	10·31 ..	2·52 ..	7·79 ..	3 2 6 ..	12 15 5
1906 ..	24,076 ..	2,349 ..	10·51 ..	9·52 ..	3·70 ..	5·82 ..	3 3 11 ..	8 4 8
1907 ..	40,782 ..	4,231 ..	9·64 ..	10·37 ..	2·87 ..	7·47 ..	2 14 6 ..	9 16 0
1908 ..	43,060 ..	4,696 ..	9·17 ..	10·90 ..	2·69 ..	8 11 ..	2 18 2 ..	11 15 9
1909 ..	37,284 ..	3,995 ..	9·33 ..	10·72 ..	3·31 ..	7·41 ..	3 4 1 ..	10 7 5
1910 ..	48,319 ..	5,390 ..	8·96 ..	11 16 ..	2·91 ..	8 25 ..	3 6 10½ ..	12 16 8
1911 ..	55,117 ..	5,472 ..	10·07 ..	9·93 ..	2·99 ..	6·94 ..	3 14 3½ ..	10 11 5
1912 ..	59,371 ..	6,239 ..	9·51 ..	10·51 ..	2·90 ..	7 61 ..	3 13 1 ..	13 5 3
1913 ..	70,348 ..	7,337 ..	9·58 ..	10·43 ..	3·60 ..	6·83 ..	3 5 1½ ..	9 8 7
1914 ..	83,030 ..	9,131 ..	9·09 ..	11·00 ..	3·83 ..	7·17 ..	3 3 2½ ..	9 1 6
1915 ..	81,520 ..	8,390 ..	9·72 ..	10·29 ..	2·32 ..	7·97 ..	3 13 10½ ..	16 7 9
1916 ..	112,356 ..	12,371 ..	9·08 ..	11·01 ..	1·99 ..	9·02 ..	3 4 1½ ..	17 13 8
1917 ..	102,601 ..	11,705 ..	8·76 ..	11·42 ..	2·96 ..	8 46 ..	4 19 5 ..	19 3 5
1918 ..	64,282 ..	7,316 ..	8·79 ..	11 39 ..	3·37 ..	8·02 ..	6 0 7½ ..	20 8 0
1919 ..	90,186 ..	9,739 ..	9·26 ..	10·80 ..	2·77 ..	8·03 ..	5 11 5 ..	24 14 1
<hr/>								
928,613 ..		99,995 ..	9·289 ..	10·77				

"The table shows the price which the sugar realized locally each year, and the cost of manufacture per ton.¹ From this latter figure has been calculated the cost of manufacture in terms of sugar per 100 of cane, so as to show in these terms what amount of sugar the factory recovers after deducting the amount equivalent to the cost of manufacture. This calculation is important, seeing that the canes were purchased from the original contracting proprietors on the basis of the value of 4½ lbs. of sugar per 100 lbs. of cane, and from the new contracting proprietors at 5 lbs. The figure varies from year to year, being influenced by the

¹ The cost of manufacturing 1 lb. of sugar increased from about one-third of a penny in the pre-war period to over a half-penny in 1919.

amount of sugar in the canes, the efficiency of the work of the factory, and by the price of sugar. This latter factor is of great importance, for obviously, when the value of sugar is high, it requires but little of that commodity to meet the cost of manufacture.

"After deducting the cost of manufacture, the figure expressed in terms of sugar ranged from 5.82 per 100 lbs. of cane in 1906 to 9.02 in 1916. In the former year it required 3.70 lbs. of sugar to meet the cost of manufacturing the sugar, 9.52 lbs., made from 100 lbs. of cane; whereas in the latter year it required only the value of 1.99 lb. of sugar to meet the cost of manufacturing the 11.01 lbs. similarly made.

"These figures are of interest in connexion with those factories which purchase their canes at a price based on the value of a given percentage of sugar."

The technical side of the work done in the factory remains to be considered. It will be remembered that, after a few years' working, the installation was considerably enlarged, and the original 6-roller mill was added to, so as to become a 14-roller one, the first of this type laid down in the British West Indies. The details of this part of the work in the factory are given in Table III, which is here reprinted with the author's comments.

TABLE III.

Year.	Purity of Diluted Juice	Fibre per 100 parts of Cane.	Sucrose per 100 parts of Cane.	Sucrose extracted per 100 Cane	Sucrose in Juice per 100 Sucrose in Cane	Juice lost in Bagasse per 100 Fibre.	Sugar made per 100 Sucrose in Juice.	Commercial Sugar made per 100 Sucrose in Cane.	Sucrose in Sugar sold per 100 Sucrose in Cane.
1905	89.2	15.1	15.3	12.5	81.7	92.2	82.6	67.5	64.9
1906	83.0	15.2	14.1	11.4	80.8	103.2	84.3	68.1	65.4
1907	87.3	15.1	14.4	12.1	84.4	80.4	85.5	72.2	69.4
1908	86.5	15.2	14.3	12.3	85.8	71.6	89.4	76.7	73.6
1909	85.8	15.6	14.2	12.1	85.6	71.7	89.1	76.3	73.2
1910	86.8	15.9	14.7	12.5	85.5	71.1	89.0	76.1	73.1
1911	84.2	15.5	14.1	12.1	85.7	70.3	82.2	70.5	67.4
1912	83.9	17.5	14.2	12.1	84.9	59.1	87.0	73.9	71.0
1913	83.0	17.7	12.9	11.8	91.1	36.6	88.7	80.8	77.5
1914	81.7	16.6	13.5	12.2	90.6	42.8	90.2	81.7	78.3
1915	83.1	16.9	12.0	11.0	91.4	40.5	93.9	85.3	82.7
1916	84.0	16.2	12.5	10.6	92.2	38.0	95.4	88.0	84.5
1917	84.8	17.4	13.0	12.1	93.0	31.1	94.6	88.0	84.6
1918	83.7	16.1	13.1	12.3	93.8	30.6	92.6	86.9	83.5
1919	83.1	16.7	12.3	11.4	92.4	35.9	95.1	87.9	84.4

"It will be observed that in 1905 there was extracted by the mill 81.7 per cent. of the sugar contained in the cane. With the use of the 14-roller mill in recent years this has been increased to a figure averaging over 91 per cent., but varying somewhat from year to year; the highest efficiency in this connexion was reached in 1918, when 93.8 per cent. of the sugar in the cane was recovered in the juice. In 1919 it was 92.4.

"Very considerable improvement has been effected in the recovery of commercial sugar from the sugar in the juice. In the first year of the factory's working the quantity of commercial sugar recovered was 82.6 per cent. of the weight of sugar in the juice; in 1919 it was 95.1 per cent.

The Antigua Central Sugar Factory.

"When the combined work of the mills and of the manufacture of sugar from the juice is considered, it is seen that in the first year of the factory's working, 1905, the weight of commercial (96°) sugar recovered was 67·5 per cent. of the weight of sugar in the cane; in 1919 it was 87·9 per cent., an increase in efficiency of 30·2 per cent. over the earlier figure, or, stated in another form, the loss in the first year was equivalent to 23·2 per cent. when compared with the work of 1919."

A brief reference is made by the author to the quality of the cane dealt with. It has been for some time a matter of concern that the richness of the canes has, during the period of the factory's working, shown a distinct deterioration as regards the sucrose content of the canes brought in. Various reasons have been assigned for this but the matter has not been as yet satisfactorily cleared up, and it will no doubt receive very careful attention in the future. It is of course natural that a fuller recovery of juice will cause a fall in its richness, but we presume that this has been taken into account. The matter of fibre is also referred to and the table shows a distinct tendency for this to be higher in the latter part of the career of the factory. The new installation was laid down in 1910 and, while the sucrose in the juice is noticeably less for the first time in 1913, the fibre content rose the year previously, and there is ground for assuming that these deteriorations are in some way connected with the increase in the size of the mill, whether in the smoothness and rapidity of dealing with the canes or in the class of canes brought in by the new contractors. But we must leave the solution of the puzzle to those on the spot, who are, moreover, fully aware of it and have already been devoting considerable attention to the matter. We notice that the fibre content has proved very difficult to determine and that this difficulty has been accentuated by an absence of accurate determinations of the amount of water used in maceration and, now that the latter is being recorded, we shall hope that this disquieting feature in the table will receive an adequate explanation. For one thing, as we have stated in the last number of the journal,¹ increased attention is being paid to the important matter of cultivation, and it may be that this factor has received less attention than it should have done, owing to the extremely successful financial position of the factory. Any improvement in the preparation of the land or treatment of the canes should have the effect of checking deterioration in the two directions here referred to.

C. A. B.

Royal Commission on the Sugar Supply. Final Wholesale Prices in the United Kingdom.

The following wholesale prices as issued by the Ministry of Food were fixed to come into force on February 21st, 1921, and remain in force until February 26th, 1921, inclusive. As the Royal Commission on the Sugar Supply discontinued all control after the latter date, these prices represent their final instructions, preliminary to a free market.

CLASS.		Wholesale, per cwt. Discount, 1½ per cent. At discretion.
1. Castor, Icing, Pulverized, Cubes, Loaf Sugar ..		
2. Granulated, Crystals, Crushed and Chips, Dry White Sugar, White Pieces (moist)		67/6.
3. W. I. Grocery Crystallized Yellow Crystals, W. I. Muscovado (moist), Pieces (other than White), W. I. Grocery Syrups	} Price must not exceed that fixed for licensed "free" sugar.	
4. Jellies, Knots, Lumps, and other Low Grade Sugar to be sold only to manufacturers		Uncontrolled.

¹ *L.S.J.*, 1921, page 72.

The Australian Sugar Industry.

Economic Expansion and White Australia.

By T. D. CHATAWAY, Ex-Senator for Queensland.

THE GEOGRAPHICAL TREND OF THE INDUSTRY.

While Australia was busy making the sugar industry of the Australian tropics a white man's industry, it did little or nothing to assist the operation except to place a duty of £6 a ton upon imported sugar. During the years of extreme competition by European beet this was entirely insufficient to enable the industry to expand. Not that the beet sugar came out to this country, but it loaded up markets which otherwise would have drawn away, as during the late war, millions of tons of black-labour-grown sugar produced within easy access of Australia. Moreover, no sooner had the few thousand coloured labourers been deported, than the press and the people of all the States except Queensland began to protest against the £6 burden upon the consumer. It is true the Commonwealth Parliament refused to lift this "burden," but the agitation against the "spoon-fed" industry, as it was called, had the most serious effect in preventing any considerable expansion. But nature had her revenge. Australia as a whole insisted that the sugar industry, if carried on at all, should be kept strictly limited to white labour, and if theories go for anything the decision should have killed the industry in the true tropics, and extended it in the sub-tropical areas of southern Queensland and northern New South Wales. However, it did nothing of the sort. The New South Wales industry is steadily disappearing before dairying, maize and banana growing. At one time that State made as much as 25,000 tons of sugar yearly; to-day it is regarded as fortunate if seasonal conditions enable it to make, with its reduced acreage, 15,000 tons. In 1909 Southern Queensland, that is south of Mackay district (about 21° south latitude), accounted for 50 per cent. of the total State area under cultivation to cane. In 1915 its proportion had fallen to 40 per cent., and in 1918 to little more than 25 per cent. Agriculture had not disappeared in Southern Queensland but had taken new forms. Seeing that up to the end of last year the whole State area under cane had, if not greatly increased, at least held its own, it is curious to realise that the Commonwealth exclusion of coloured labour, which was expected to empty the north or true tropics, has been followed by increased production where it should have decreased, and by decreased production in the south, where it was expected to increase. In other words, regardless of ethnographical considerations, the industry is steadily working its way into the areas most suited to cane production, whatever they may be considered—climatically—for the white man.

But if this has happened in the green twig, what may we not expect in the dry? If with the higher cost of labour in the north and the low price of the product the expansion of the industry was steadily towards the equator, what may we now anticipate with the relative cost of northern and southern labour remaining the same but the price of the product increasing by one-third? This past year an unsuccessful mill in the Bundaberg (southern) district has been removed to the Johnstone (northern) area. Already two new large mills in the north are considered, *pace* the seasons, to be fully supplied with cane, while another is taking steps to double for 1922 its not inconsiderable capacity of 7000 tons or more. The Government manager of the Bureau of Central Sugar Mills is directing attention to the necessity for more crushing power in what has hitherto been regarded as the almost inaccessible north, and consideration is being given to opening up large

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areas which were acquired thirty years ago for cane cultivation, but which have remained idle ever since, while the industry has been under a cloud. It may be that the assurance of fair prices for sugar this year and next may stimulate cultivation in the sub-tropical areas, but this remains to be seen. Meanwhile the undertaking of the central Government, which is the first and very belated recognition of the value of the sugar industry as a part of the White Australian policy, is stimulating cultivation and manufacture in the fully tropical districts.

THE GOVERNMENT AGREEMENT WITH THE INDUSTRY.

Briefly summarized, the Commonwealth Government, with the approval of the House of Representatives, last March made an agreement, to which the growers, millers, workers and Governments of the Commonwealth and State of Queensland were parties. It was a long and somewhat complicated document, the value of which must very largely depend (as was pointed out by the HON. F. BAMFORD, member for the Herbert division in the House of Representatives) upon the loyal observance of the conditions by the white workers in the fields and mills. The Queensland Government had commandeered the output and the Commonwealth agreed to take it off its hands. The price to be paid for raw sugar of 94 per cent. net titre was fixed at £30 Gs. 8d. per ton, or roughly about £10 more than the Commonwealth allowed during the latter part of the war period. Though this figure is by no means on a parity with that of the world's markets, the Queensland sugar growers can hardly yet believe their own good fortune. Cinderella has at last been given something wherewith to clothe herself. For probably the first time in the history of the sugar industry the officials of the Australian Sugar Producers' Association are travelling through the northern districts strongly urging the farmers to increase their cultivation. This is in fulfilment of a promise to the Government that every effort would be made to reduce to its utmost the loss the Government must sustain in importing foreign sugars for sale to consumers at 6d. per lb. It is needless to say that seasonal conditions are the primary factor in determining output, but apart from these there is on all hands in the north an expansion of cultivation. The two combined in 1921 should supply cane sufficient to make, according to official estimates, 230,000 tons of sugar in the northern districts alone. To this may be added probably 60,000 for Southern Queensland and 20,000 for New South Wales and Victoria (beet). If these estimates are realised, Australia will be fully supplied with sugar for ordinary consumption and also for the rapidly expanding jam, condensed milk and confectionery export trades. Further, again allowing for good seasons, the prospects are that Australia will in 1922 produce sugar in excess of local requirements even after providing for the increased consumption which must follow the anticipated influx of additional population. In 1923, if the expansion continues, Australia will be able to export sugar, and it now remains to be seen whether she will by then have fitted herself to compete in the open market. For the time being the markets of the world are of course most attractive, but with the recovery of production prices may be expected to recede. That for many years they will fall to near the pre-war level seems highly improbable, especially in view of the fact that the general increase in the remuneration of all labour—white and black—throughout the world is creating a permanently increased consumption, and at a rate which is probably hardly appreciated.

FUTURE PROSPECTS.

The future of the Australian sugar industry may now be considered at stake. The area planted to cane to-day, and the milling power, are sufficient, in normal seasons, to supply all the sugar requirements of the Commonwealth, while great

profits would be made if there were a surplus for export. Two questions remain to be answered—first, can Australia maintain her White Australia policy and also find the people to increase her sugar production to the fullest extent of her tropical agricultural lands; and second, can she pay the price and yet successfully compete in the open markets with sugars produced by coloured labour? I take the second question first, because unless we can answer it in the affirmative, the other requires no answer. Cane sugar, as already mentioned, is not Australia's real competitor, but European beet. To meet that competition, which may easily in a few years become as acute as it was a quarter of a century ago, the cane sugar industry must equal the beet in its organization, its mechanical economy and the elimination of all waste by the conversion of its by-products into a source of income. Before the West India Royal Commission was appointed some twenty-five years ago I wrote in the *Times*, London, that the real profits of the beet industry came out of its by-products, and that the cane industry should seek to follow the example.

POSSIBLE ECONOMIES IN PRODUCTION.

About a year ago the *International Sugar Journal* published some speculations of mine regarding the wastes in and possible expansion of the Australian cane industry. Since then, with the definite encouragement of the three years' agreement with the Commonwealth Government, the present producers of sugar have taken on a new lease of life, as it were, and have set to work to eliminate waste, and to strengthen their position against the inevitable fall in the world's prices. The past season has been a very poor one—the third in succession—and there is little ready cash available for new ventures, but the prospects now are excellent and the captains of the industry are prepared to discount the future in order to do at once those things which during the years of stagnation they have neglected. The matter of converting the wasted molasses into fuel alcohol is likely soon to be an accomplished fact. The use of tractors in the fields is rapidly increasing, though recently in places they have been standing idle for want of fuel while the molasses of the near-by mills have been running to waste, or put to their least valuable uses. Such an anomaly, now that capital can be commanded to erect distilleries, will not long continue. The mechanical handling of sugar in 200 lbs. bags will soon become general. Hitherto with few exceptions this economy has been ignored. At Cairns, where some 35,000 tons of sugar are loaded each year into steamers, the cost of man-handling has reached the alarming figure of 8s. 6d. per ton, and steps are being taken to instal mechanical appliances which should reduce this charge by 75 per cent. The long narrow-gauge railway, connecting Brisbane with Cairns, and linking up the sugar districts along the coast from south of Mackay to north of Cairns, will soon be completed, and with improved communications the unnecessary costs incurred by disturbances in the shipping trade will be largely eliminated.

MECHANICAL HARVESTING AND THE DISPOSAL OF "TOPS."

The harvesting of cane by mechanical means is again attracting attention. Recently in Tasmania it appeared that the hop-growing industry was doomed to extinction on account of the cost of harvesting and the scarcity of labour. The idea of a machine to pick hops seemed chimerical, and in any case the cost of the suggested machine was too great for the small growers. Yet a machine, costing about £5,000, was built, and a harvesting company undertook to work it. The result, I was informed by a Tasmanian member of the House of Representatives, has been a signal success. The work was done more quickly and at half the cost.

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An industry which seemed doomed has been saved. The chief objections raised so far to cane-cutting machines are that they are too expensive and they will not "top" the cane. The farmer can seldom be persuaded to interest himself in an appliance which is far beyond his individual means. Yet harvesting machinery must be found and if, when found, it is too expensive for the individual, the difficulty must be overcome in the same way that Tasmania dealt with the hop-picking. In some countries rice is still harvested in the most primitive manner, with a sickle, or even a pair of scissors; yet in California rice is harvested by machinery, as we harvest wheat, and instead of the grain being trodden out by oxen or beaten out with flails it is rapidly and economically threshed out by a machine, with a minimum of labour cost and an entire absence of wasted by-products. In the cane fields to-day we still cut cane with a machete, and leave behind, for the most part to rot on the ground, the valuable tops of the stalks. Some are certainly chaffed roughly for horse-feed, but still less go to make ensilage. Yet it is calculated that every ton of tops would yield, according to variety and other conditions, from four to seven gallons of absolutely pure alcohol, worth with petrol at 3s. a gallon about 2s. 2d. a gallon, or 8s. 8d. to 15s. 2d. per ton of tops. The proportion of the cane which is left in the field as "tops" cannot of course be exactly stated, for so much depends upon the growth and treatment of the cane before harvesting, but possibly 5 per cent. of the weight of the cane cut would not be too much. In such a case a crop going 40 tons to the acre would give 2 tons of tops, yielding alcohol worth 17s. 4d. to 30s. 4d. per acre. Now that practically all cane is carried to the mills by light railways the cost of taking the cane untopped into the mill-yards would not be excessive. Thus the tops could be robbed of their alcohol and the inventor of a cane-cutter saved the heart-breaking task of designing a machine which would top cane as it moves along in a field. A simple appliance for topping at the mill should offer no difficulties, after which the extraction of the alcohol would be the work of the distillery plant. A mill crushing 80,000 tons of cane would on the calculations quoted above secure fuel alcohol worth from £1,700 to £3,000, which would constitute a handsome addition to the alcohol obtained from its molasses.

OIL v. BAGASSE AS A FUEL.

Recently I directed the attention of Australian sugar producers to the possibility of making better use of their bagasse than simply burning it. Subsequently I read an interesting report¹ by ARTHUR D. LITTLE, Inc., on "The paper making qualities of Hawaiian bagasse." The article deals with the question of maintaining a sufficient supply of bagasse to enable a pulp and paper mill to work for 300 days in the year. Australia imports wood pulp for paper making from Norway, Sweden, and Canada, and if she can bring wood pulp across the world I see no obstacle to bagasse pulp being brought from North Queensland down to the southern paper mills. Mr. LITTLE fully establishes the value of bagasse for paper making. The question suggests itself as to what fuel could be used in its stead. Certain Hawaiian observations place the evaporating value of petroleum at practically four times that of bagasse (Newlands), so that we may assume that four tons of bagasse are required to do the work of one ton of oil. By evidence taken before a Royal Commission on the Australian sugar industry in 1919 it was made abundantly clear that, if the mills could be kept regularly supplied with cane throughout the crushing season the resultant bagasse would supply all the fuel required without supplementation by wood, molasses or other products. So we arrive at

¹ I.E.S.J., 1920, 453.

the result that 5 cwt. of oil per ton of sugar produced would supply all the necessary fuel. That oil would, apart from its initial cost, be very much cleaner, and labour and steam saving, hardly admits, I think, of argument. The bagasse as it emerged from the last set of rollers would be diverted to the pulping plant, and thenceforward becomes a charge against the paper industry at the credit of sugar. I have no room to pursue this fascinating subject, but it is only right to add that wood pulp has trebled in value of recent years, which means also that bagasse for paper making is worth three times what it was before 1914. Based upon Washington figures of 1909 bagasse should now be worth at least £2 a ton, and it may be taken as certain that 5 cwt. of oil would not cost more than £1. Incidentally it may be remarked that it may be found possible in this additional treatment of the bagasse to save for alcohol manufacture the 4 to 5 per cent. of sugar which usually escapes into the fires.

ECONOMIC CONSIDERATIONS.

In a short review of the position and prospects of the Australian sugar industry I cannot attempt to go into numerous details of the minor forms of economy which may serve to enable the country to export at a profit even after the world's markets have somewhat adjusted themselves. The time of prosperity is usually the time of extravagance, but there is an indication that the industry will use the term of its agreement with the Commonwealth to better purpose. I have already mentioned some of the outstanding points of reform, but there is a general measure of improvement which is not so easily defined; without interfering with the small farm system, which is the backbone of the industry, there is room for more co-operative effort. There is work to be done which is common to every farm, and economy demands that such work should be done in common. Our tramway systems afford an excellent analogy. Instead of thousands of horses, carts, drivers and stablemen, and the concomitant expenses in time and labour of feeding the first, maintenance of carts and harness, and of housing men, beasts and vehicles—the whole to perform the task common to all of taking the cane from the fields to the mills—the work is done in common by the tramways. The individual's responsibility for haulage ceases at the edge of his farm. If the common task of cutting and loading cane were also performed by co-operative effort, then no cost of machinery would stand in the way. Organized effort in this and other respects, which will suggest themselves, will adapt to the industry the advantages of the big plantation system while retaining those of the small farms, with their personal interests and personal initiative.

Improved varieties of cane and methods of cultivation, greater control of pests, and the intelligent application of the discoveries of science, have already increased the yield per acre of both cane and sugar. In 1907 for the first time in its history since 1877 the industry produced two tons of sugar to the acre harvested. In the next ten years we find the returns:—

Year	Tons	Year	Tons
1910	2.20	1916	2.33
1913	2.36	1917	2.83
1914	2.09		

The above includes the returns for all Queensland, and from cane, whether plant, first, second, or even older ratoons. The three years, 1918-20, have given less, for they have been years of drought or storm disaster, against which the growers could not prevail. The introduction of the small farm with consequent intenser cultivation may in part account for the improvement, but better farming generally and better mill work is to a greater extent responsible. And this form of progress

The Australian Sugar Industry.

can continue. Thirty years ago science was unknown in the sugar industry, except to the refiners; to-day chemical, entomological, botanical and agricultural experts are in every sugar district and at every farmer's and mill manager's elbow. Even the medical experts are busy seeking the identification of tropical diseases amongst the white people, helping to develop healthy white children in the tropics, and striving to show how what was once considered to be the white man's cemetery may yet become his health resort.

SOME ASPECTS OF THE WHITE AUSTRALIA POLICY.

And this brings me now to my first question: Can Australia maintain her White Australia policy and also find people to increase her sugar production to the fullest extent of her tropical agricultural lands? I have already indicated that the sugar industry is moving northwards towards the equator. Fifty years back it was chiefly about the 29th parallel of south latitude; to-day it is pushing northwards from the 17th parallel. But in the earlier periods the white men were for the most part Anglo-Saxons, while to-day the Anglo-Saxon becomes less and less conspicuous the further north we go. On the Herbert river, slightly north of Townsville, it is said that 95 per cent. of the large farming population is Italian. A witness before a Royal Commission in 1919—an old journalist—stated that with the help of the local police he had found that of 795 labourers on the Russell and Mulgrave rivers the nationalities were as follows: 500 Italians, 14 Austrians, 40 Maltese, 45 Danes, 42 Japanese, 42 Russians, 8 Germans, 50 Hindus, 4 Frenchmen, and 50 Chinese. The secretary of a powerful labour union put the matter this way, "In the South, at Bundaberg, Childers and round those parts, foreigners consist of 10 per cent., in Mackay about 15 per cent.; and from there North, on the Herbert river it is probably 90 per cent. of foreigners, mostly Italians; in other places they are 60 to 70 per cent. of those engaged in the industry." Early in 1919 Mr. C. E. JODRELL, a well-known farmer on a considerable scale, who lives on the Johnstone river, just south of Cairns, wrote in the *Australian Sugar Journal* an article admitting that the Italians are buying out the British farmers, and regarded the fact as perfectly intelligible. He declared that the British worker was less able to stand the climate than the people of the Mediterranean littoral. He is more subject to tropical diseases, such as malaria, hookworm, sprue, etc., and—what perhaps is infinitely worse—he apparently much more readily gives way to drink: consequently he falls out of the fight, and his more swarthy competitor comes out the victor. The census, which will be taken this year, will afford a check upon these opinions as to the usurpation of the Northern tropical lands and employment thereon by nationalities which, though classed as white, are nevertheless far removed from being Anglo-Saxon.

Various efforts, apart from the teachings of the medical faculty, have been put forth to keep the British settlers and workers in the tropics. At one time, soon after the abolition of coloured labour, representatives of the workers sought the opportunity of making small homes for themselves in the Mackay district, with an acre or two for cultivation, much as the Indians, imported into the West Indies, were given homes. The settlement of the white worker in this manner failed, but I read lately that the system, modified to include raising a few sheep, is again being tried further North, and some measure of success is claimed. The obvious objection to the Mackay plan is that if the worker cultivates at all he can only grow sugar cane, and the more time he devotes to that the less time he has to give to the employer who is engaged in the same cultivation, only on a larger scale. But the supreme objection is that the system of settlement right alongside

the work does not give the women and children any relief from the tropical climate, nor the man any chance to recuperate. A more promising plan was put forward by me about fourteen years ago. The sugar cane areas lie almost at sea level, but behind them, in some cases only a few miles, are quite steep ascents up to 2000 ft. and more above the low-lying plains. These hills are abrupt only on the ocean side, and on the western side fall away gradually to the inland downs and plains. It is on these highlands that the workers should be encouraged to make their homes. There they can grow the fruits and vegetables of the temperate climes, which the people along the coastline now have to import from the South. The atmosphere is generally dry, the nights are cool even to coldness, and such women and children as already live there present a striking contrast with the coast dwellers in general looks and health. The worker in the cane fields and mills would have an incentive to save his money, and within a few hours of finishing his job could reach his home in a bracing climate and away from the eternal sugar cane. During the wet season idleness is perforce general, and men with no homes seek to counteract with drink the lassitude caused by prolonged labour in the humid atmosphere. On the highlands the rainfall is neither so severe nor so continuous. The clouds pass over the mountains, and the sun shines out to disperse the resultant mists, while the low-lying coastal lands continue for days and weeks blanketed by an atmosphere humid almost to the point of saturation. With a closely settled married population upon these highlands, having its homes and not unprofitable gardens and orchards, the restless nomads who travel the sugar districts, work, drink, and strike, would soon cease to be the bane of the industry; and with a reliable, however well paid, labour supply at his door the Anglo-Saxon would no longer sell out to the Italian, nor would he find himself compelled to employ the polyglot bands of labourers who now offer their services on their own terms.

The Commonwealth Government, through its officials, insists that no fresh coloured labour is coming into the country; that those in the North have either always been there or have drifted thither from other parts of Australia. The census will tell us if the Government is right. If it is, White Australia is being maintained, and we are settling our tropics with white people, of whom there is likely to be an unlimited supply, but, if no effort is made to improve the conditions of the married Anglo-Saxon worker and so bring relief to the Anglo-Saxon farmer, it would seem that tropical White Australia is likely to have a very swarthy complexion and speak with a foreign tongue. If the Government is wrong, and coloured labour is illicitly penetrating into the northern portions of the Commonwealth, then the whole position may once more call for review.

S. KOSTYCHEV¹ stated in a recent paper that dextrose and alcohol were formed by *Aspergillus niger* from the following substances: *d*-tartaric acid, glycerol, quinic acid, mannitol, and lactic acid. On the other hand, the sugar mentioned was not formed from peptone.

SIR EDWARD DAVSON, President of the Associated Chambers of Commerce of the British West Indies, has suggested that a trade agreement should be entered into with the Mother Country for a period of ten years, on the same lines as that entered into with Canada. Any such step would be of immense advantage to the Islands. SIR EDWARD DAVSON is also urging that the important question of a West Indian currency, which has previously been considered though not unanimously, should now receive fresh consideration; if the West Indian colonies adopted their own coinage, the seigniorage rights would bring in possibly £80,000 per annum.

¹ *Zetsch. physiol. Chem.* 1920, 111, 238-245.

Data concerning the Advantages, Production, and Cost of "Natilite" Motor Fuel.

THE WORLD'S MOTOR FUEL POSITION.

One of the most striking developments of the past few decades has been the immense expansion of mechanical transport, an especially notable feature of which has been the great increase in the number of vehicles, for the propulsion of which internal combustion engines are employed. As the result of this remarkable change, the economic life of the community in most countries of the world has become largely dependent upon the use of motor-driven cars for the transport of passengers or goods. It is hardly necessary to offer statistical evidence on this point, the great importance in industrial and private life of motor cars, commercial vans and trucks, omnibuses, agricultural tractors, seacraft, and aircraft being a matter that is quite fully realized.

Hitherto petrol or gasoline, the distillate boiling between 70° and 120°C., obtained from petroleum oil, has been mainly used as the liquid fuel for carbureting engines; but a serious aspect of the future position of motor transport is the insufficiency of the supply of this spirit to meet the required demand. Thus, in a paper recently read before the American Institute of Mining and Mechanical Engineers, Mr. GEORGE OTIS SMITH¹ said that "the position of the United States in regard to oil can best be characterized as precarious. Using more than one-third of a billion barrels a year they were drawing not only from the underground pools, but also from storage, and both of these supplies were limited. . . ." Again, Mr. C. NARAMORE,² in emphasizing the condition of the fuel industry, pointed out that "although each year saw vast increases in the sale and export of oil from America, there had been no increase in production from the actual wells, the aforesaid increase in sale and export being for the most part drawn from storage. The deficit caused by this can never be replaced under the existing conditions. The last year or two had seen the working of the last well in the United States which had not been explored; it is in Texas, and is now practically in full working order. Taken as a whole, the oil wells of the United States are producing a prodigious quantity of fuel, which is, and for a few years will be, sufficient to quench the thirst of the passenger cars of the United States, but they cannot export enormous quantities to foreign countries as well. . . ."

In order to cope to some extent with this serious shortage of a necessary commodity, higher boiling distillates of petroleum oil, and likewise lower fractions, have been pressed into service. Mixtures of volatile hydrocarbons condensed from the natural gas have been mixed with the heavier distillates; while spirits low in vapour tension have been obtained by encroaching into the kerosene fraction, the difficulty of starting the engine with such liquids being overcome by admixture with a greater or less amount of petrol. Moreover, a great increase in the proportion of spirit yielded by the distillation of crude petroleum oil has been obtained by the discovery of certain processes for "cracking" the heavier fractions, that is, processes of heating the oil to a high temperature in the absence of air, whereby a larger yield of volatile products can be obtained than in direct distillation. But notwithstanding these efforts the petrol spirit famine remains imminent, and for the reason stated above, namely, that the world's supplies of crude petroleum oil from which the petrol is produced are rapidly being depleted.

¹ *Mineral Resources of the U. S., 1917*—Part I, published December 28th, 1918.

² *The Motor*, February 25th, 1920, p. 187.

In the words of a report recently issued by the Board of Trade¹ on the investigation of costs, prices, and profits at all stages in respect of petrol, the position is that "there is a grave danger of a permanent world famine in motor spirit, even at fabulous prices."

POSSIBLE SUBSTITUTES FOR PETROL.

In view of this approaching crisis, one might expect that other materials likely to serve as suitable substitutes for the light distillates of mineral oil have been eagerly sought, and this has been so ever since the price of petrol commenced to rise. At this point it may be remarked that the main two desiderata for a suitable liquid fuel to serve as a petrol substitute are: (1) That it should have a sufficiently high vapour pressure, that is, it should be sufficiently volatile to permit the starting of an engine from the cold; and (2) it must be capable of production at a sufficiently low cost and in a sufficiently large amount to meet the market requirements of the day. There are at the present time only two liquids that are worth considering as fulfilling one or both of these requirements to an adequate degree, namely, benzol and alcohol.

BENZOL AS A MOTOR FUEL.

Benzol is a spirit obtained by the destructive distillation of coal, being the constituent of coal gas which is largely responsible for its illuminating power. Its chief constituent is benzene, which when pure possesses a boiling point of about 80° C. Commercial benzol, which contains about 70 per cent. of benzene, nearly 30 per cent. of toluene, and traces of xylenes, has been found to give excellent results as a fuel for automobiles, in which it can be used without modification of the construction of the engine. It very closely fulfils the technical demands for a satisfactory spirit; but it unfortunately fails to meet the second condition specified above, since its output is strictly limited, and indeed is actually decreasing, in spite of the fact that the amount produced by the "stripping" of coke-oven gas has been largely increased during recent years.

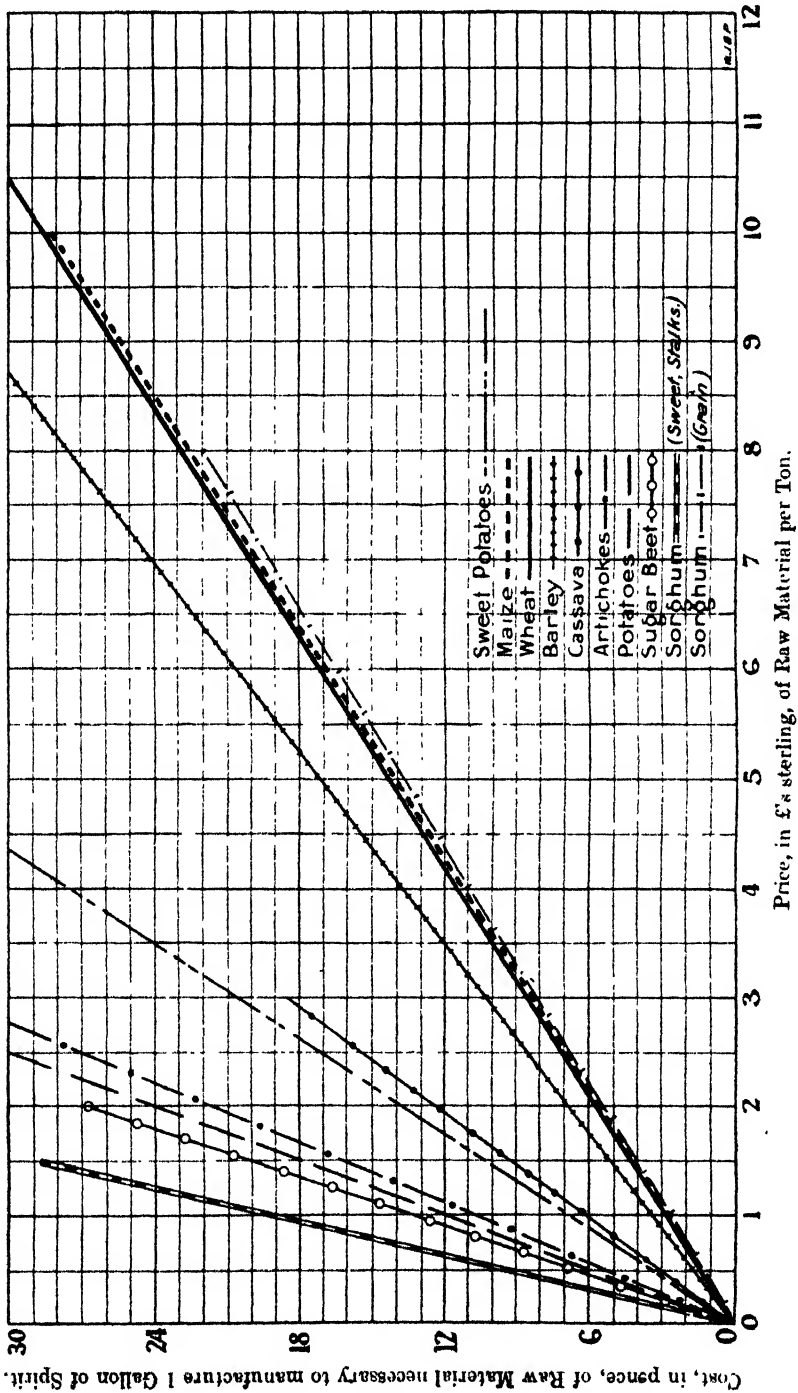
ALCOHOL AS A MOTOR FUEL.

Alcohol, or some fuel containing alcohol as a base, therefore remains the only alternative substitute for petrol or gasoline. Its pre-eminent advantage (upon which too much stress cannot be laid) is that compared with petrol or benzol, its supply is inexhaustible for all time, seeing that it is readily and cheaply produced by the fermentation of the carbohydrates present in plants. These carbohydrates may already be in a condition capable of direct transformation by the yeast; or may consist principally of starch or cellulose which must first be formed into glucose or fermentable sugar, previous to its conversion to alcohol by the growth of the yeast cell in the fermenting vat. But the great fact is that, as vegetable matter will presumably continue to be produced in almost unlimited quantity so long as human life is possible, here is a never-ending and likewise a cheap source of motor fuel for universal use.

Regarding the properties of alcohol for the purpose under discussion, it may be pointed out that, although low in calorific value, it requires less air for its combustion than petrol, and that therefore less heat passes to the exhaust. Moreover, if arrangements be made to increase the compression of the engine, alcohol will yield approximately the same power as will petrol. A further matter that may perhaps be worth mentioning is that it possesses a higher specific gravity than petrol (8.2 lbs. per imperial gallon, against about 7.2 lb.), a point in its favour when it is sold by volume and not by weight.

¹ *The Times*, March 2nd, 1920.

POWER-ALCOHOL.—GRAPH SHOWING THE COST OF THE RAW MATERIAL NECESSARY FOR THE MANUFACTURE OF 1 GALLON OF SPIRIT (95 PER CENT.).



DISADVANTAGES OF ALCOHOL WHEN USED ALONE.

On the other hand, it must be emphasized that the use of alcohol by itself is attended with certain marked disadvantages. While it can be used in internal combustion engines by special arrangements for starting on petrol, and with devices for heating the intake branch of the engine, the engine must be made with a higher initial compression than is generally used with petrol or benzol. Again, owing to its readiness to oxidation to acetic acid on ignition, it possesses the great defect of causing the pitting or corrosion of parts of the engine. It follows, therefore, that alcohol used alone can hardly be regarded as a practical fuel for use as an alternative source of power to petrol or benzol.

ADVANTAGES OF AN ALCOHOL-ETHER MIXTURE.

These facts compel the consideration of the admixture of alcohol with some material capable of overcoming the disadvantages noted above. After many years of experimenting with mixtures of alcohol with naphthalene, acetone, acetylene, and lastly with ether, it has been definitely established by means of authoritative tests that the most perfect fuel that could be devised is a mixture consisting of 55 per cent. of alcohol, 44.9 of ether, and 0.1 per cent. of ammonia, this latter constituent being present for the purpose of neutralizing any acetic acid formed in the case of engines with a very bad carburation. It has been found entirely successful in correcting this defect, and corrosion and pitting when using this mixture are entirely prevented.

"NATILITE."

This liquid fuel mixture was first produced in Natal, and hence the name "Natilite" or "Natalite," by which it is now very well known. It has been patented in all countries throughout the world,¹ and the names mentioned have been likewise universally registered as trade marks for the product.

Long and continuous experience with "Natilite" has now quite conclusively established the following facts, which are further confirmed by authorities, such as the late Prof. VIVIAN B. LEWES,² F.I.C., F.C.S.; The Royal Automobile Club, the Transvaal Automobile Club,⁴ and by Mr. PERCY L. WESTON,⁵ B.Sc., B.E. (Mech. and Elec.), Lecturer in Electrical Engineering, University of Queensland, Brisbane:—

(1) "Natilite" can replace petrol as fuel in an internal combustion engine with a carburettor designed for petrol, and is then as good as or better than petrol for producing power. (2) It has no corrosive effect on the metal parts of cylinders or valves. (3) It gives superior results to petrol gallon for gallon when used in an engine the compression and carburation of which has been adjusted for its special use (an adjustment that can be readily and inexpensively carried out). (4) In the case of fire it can be extinguished with water, whereas with petrol this is not possible. (5) It will not freeze, an important consideration in cold climates, and for aviation at high altitudes. (6) An engine can be started more easily from the cold with "Natilite" under all conditions of weather than from petrol.

MANUFACTURE OF "NATILITE."

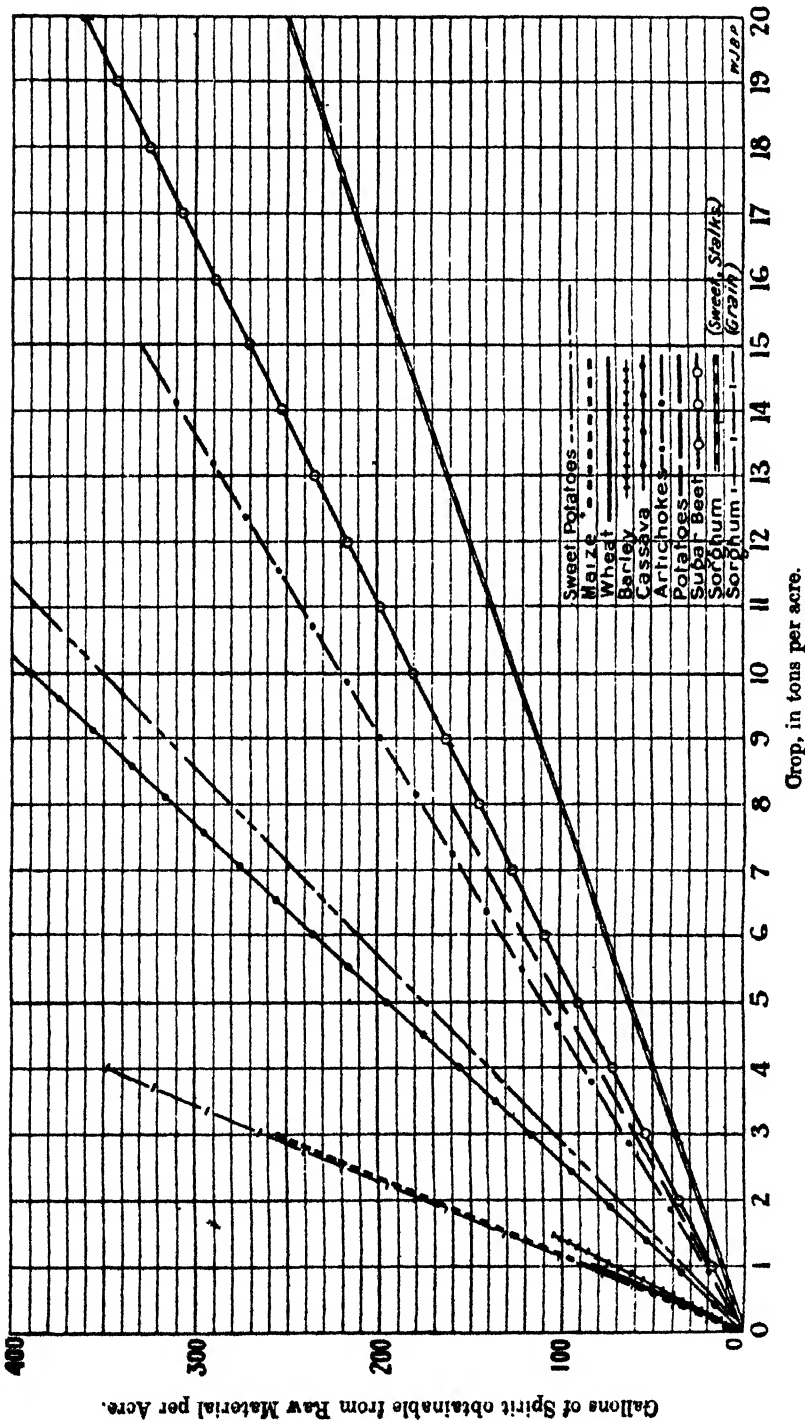
Over four years of manufacturing experience on a fairly large scale has shown that "Natilite" can be easily produced from molasses, sago, sorghum, and other products containing carbohydrates in sufficient amount. Data are now available demonstrating that it can be produced from these raw materials at a comparatively

¹ U.K. Patent, 24,262 of 1914; 17017 of 1915; 375,453 of 1916; and 378,700 of 1917

² Report on "Natalite" Motor Spirit, dated June, 1915 ³ Reports dated June 1st, 1915.

⁴ Report dated April 28th, 1916. ⁵ Report dated May 2nd, 1917.

POWER-ALCOHOL.—GRAPH SHOWING GALLONS OF SPIRIT (95 PER CENT.) OBTAINABLE FROM RAW MATERIAL PER ACRE OF VARIOUS CULTIVATED CROPS.



low cost; that it can be sold at prices below those of petrol and benzol; and that its commercial exploitation is capable of realizing very large profits. There should be no technical or practical difficulties in the way of the establishment of "Natilite" factories in any part of the world where the raw materials named above are found in sufficient quantity. Another fact of importance is that the handling, storage, transport and distribution of this motor fuel can be accomplished without difficulty in any country.

ITS COST OF PRODUCTION, USING MOLASSES.

Regarding the important matter of the cost of production, this will naturally vary according to the climate, transport, and the supplies of raw material. It is possible to cite figures showing that distillation plants have been designed capable of producing "Natilite" at 7d. per gallon, or adding 1d. as an average estimate for labour and depreciation, 8d. per gallon; the price of molasses containing 50 per cent. of total sugars (sucrose and reducing sugars) being taken as 1d. per gallon, and coal at £1 per ton. To these figures must of course be added the costs of storage, transport and distribution, but on the other hand these charges can be largely offset by the sale of by-products recoverable in the manufacture of the fuel.

Makers of such plants are prepared, we understand, to guarantee definite costs of production. Therefore, with the practically unlimited market for motor fuels which has been emphasized above, the erection of a "Natilite" factory is a proposition that can be regarded as non-speculative in its character. At the present time the largest factory is at Merebank, Natal, the capacity of which is being increased to 2,000,000 gallons per annum.

It must be borne in mind that sugar factories can only supply molasses as a raw material for "Natilite" production for the limited period of the year during which they are grinding. Although not a necessity, it is at any rate advisable that provision should be made for keeping the distillation plant running through the year. This can be accomplished in two ways, namely: (1) by converting all the factory molasses obtainable into alcohol within the period during which it is available, and storing a sufficient quantity to keep the ether and mixing plants running for the remainder of the year; or (2) by providing another source of raw material upon which to operate during that period of the year when factory molasses is not being produced within a certain vicinity.

ITS COST OF PRODUCTION USING OTHER RAW MATERIALS.

Of these two alternatives, the latter is the better business proposition. It is one, however, that will require a year or two for development, a certain amount of investigation for the purpose of determining the most suitable crop for the climate and soil concerned being necessary. In connexion with this point, it is well worth while directing attention to the cost figures published in the Interim Report of a Special Commission on Alcohol Fuel and Engines appointed by the Commonwealth of Australia,¹ which figures are well summarized by means of the graphs herewith reproduced. These graphs clearly show: (1) the cost of the materials necessary for the manufacture of 1 imp. gallon of 95 per cent. alcohol, the yields per ton (of 2240 lbs.) in the cases of the several materials being for sweet potatoes, 35; maize, 85; wheat, 83; barley, 70; cassava, 39; artichokes, 22; potatoes, 20; sugar beet, 18; sorghum stalks, 12·5; and sorghum grains, 87 gallons; and also (2) the gallons of 95 per cent. spirit obtainable from these various raw materials per acre of the various crops.

¹ "Power Alcohol," Bulletin 6; Advisory Council of Science and Industry, Melbourne, 1918.

The Advantages, Production, and Cost of "Natilite" Motor Fuel.

In concluding this first contribution, no apology need be offered for devoting so much space to the subject, for the reason that, notwithstanding all the discussion that has taken place on the subject of the possibilities of industrial alcohol, this is the first development to take place in the direction of a broad and practical commercial undertaking, one that will enable sugar manufacturers everywhere to make profitable use of a by-product that in some countries is run to waste, and one that will provide a permanent and lucrative source of revenue.¹ In fact, summing up the several advantages which have been dealt with above, it may be accepted that "Natilite" offers a solution of the world's fuel problem.

(To be continued.)

Sugar Cane Blight in Trinidad.

A Summary of Conclusions.²

By W. NOWELL, D.I.C., and C. B. WILLIAMS, M.A., F.E.S.

THE FROGHOPPER.

An infestation of froghoppers can produce a definite form of blight without necessary co-operation of other insect or fungus agencies.

The characters of the condition so produced consist of:—(a) Leaf injury, beginning with the formation of elongated spots and patches, pale at first, then red brown, and finally dry and silvery brown; which injury in well-developed infestations results in the premature withering of most or all of the leaves. (b) The more or less complete arrest of growth, in which the well-developed canes in a stool suffer little, the youngest shoots die outright, and the shoots of intermediate age are affected in inverse proportion to their size. (It follows from this that the better the canes are developed the greater is their resisting power). This condition differs, in plainly recognizable characters, from that produced by any form of root disease known to the writers.

In some cases the appearances produced agree very closely with those described for the Sereh disease of Java, but the subsequent history of the stools shows that the resemblance is one of appearance only, the continued degeneration in successive years characteristic of Sereh being entirely absent. Nothing has been seen to suggest that the Mottling or Mosaic disease, now giving trouble in Porto Rico and Louisiana, is involved in the production of blight.

The general condition described seems to be mainly the result of injury to the leaves, as appears both from the observation of attacks and from consideration of the symptoms of the affected stools. This conclusion is supported by the following evidence:—(a) The condition reaches its most acute phase shortly after the chief flights of adult froghoppers. (b) Where there is no complication with root disease or hindrance by drought, the stools, even in the case of low ratoons in which all or nearly all the shoots are killed to the ground, resume vigorous growth when the brood of froghoppers is passed. (c) The root system and underground stem system in these uncomplicated cases do not appear on examination to be seriously affected.

¹ The owners of the unsold "Natilite" patents are: The Alcohol Fuel Corporation, Ltd., 7, Princes Street, London, S.W. 1, from whom all particulars regarding terms can be obtained.

² Prepared as a preliminary report on investigations in 1919, and published in the *Bulletin of the Department of Agriculture, Trinidad and Tobago*, (Vol. XIX, 1920, part 1), from which it is here reproduced. The original paragraphing has been somewhat altered here to suit considerations of space.

In the present year (1919), which is one in which the froghopper is near its minimum, the third brood infestations can be classified as follows :—(a) A belt of infestation in the Naparimas which coincides closely with the occurrence, in bands and patches, of a particular type of red clay soil. (b) An area of several acres in the Northern sugar district in which the soil, a fine silt, is closely compacted and probably sour. (c) Scattered small patches mostly with no immediately recognizable defect in conditions, but strictly local, frequently distinctly related to the contour of the ground, and surrounded by large areas of healthy cultivation.

These infestations are of a type approaching in local numbers and severity the more widespread infestations of maximum froghopper years. Froghoppers are very lightly distributed through the unaffected fields, therefore the damage does not arise from the local accentuated action of insects generally distributed, but from the development of the insects in large numbers where the local conditions of a field or patch especially favour it. In some cases the patches of infestation and damage are sharply defined from the rest of the crop in the same field.

From consideration of the effects of difference of rainfall in certain periods and certain districts and from local observations of soil and see page effects, it appears most probable that the conditions governing the development of froghopper infestation arise in some way not understood from a soil and moisture relation. A merely backward or stunted condition of the crop is not in itself sufficient to induce a froghopper infestation. There are very many such fields this year which are quite free from blight.

ROOT DISEASE.

The fungi capable of causing root disease of sugar cane at present known in Trinidad belong to the genera *Marasmius* and *Odontia*. They occur to some extent in all cane fields, but vary very greatly in quantity and development in different fields and at different seasons. Under conditions favourable to the cane they can be present in notable quantity without any visible ill effects, existing on dead or dying material only. Root disease is brought about when, for any reason, these fungi are enabled to attack parts of the living plant. Any factor adversely affecting the vigour of the cane may decrease its resistance sufficiently to allow of the development of root disease.

The common type of root disease consists of the invasion and destruction of the roots. Its effects are difficult to distinguish from the direct effects of defective aeration or poverty of soil. There is a much rarer and much more severe type, due as it appears to certain species of *Marasmius*, in which the base of the stem is killed for several joints, the death of the whole cane following in consequence. There is a field of first ratoons at present under observation attacked by this severer form of the disease when the canes were already well-grown and large, which seems likely to be practically destroyed. In this case there was distinct injury to the leaves by froghoppers in August and again in October. The field would be known locally as blighted, but the real cause of the injury, as shown by its nature, is the root fungus infestation.

It now appears that the prevalence of root disease over wide areas in Trinidad late in the season, reported on last year by one of us (W.N.), is largely due to the weakening of resistance by previous attacks of froghopper. The effect of root disease accompanying or following froghopper injury is to increase its effects and to prevent recovery, making the blighted condition permanent.

CONTROL.

No direct method for control of the froghopper is at present in sight. Natural enemies, especially the fungus diseases of the adults, exercise a considerable

Sugar Cane Blight In Trinidad.

measure of control under favourable conditions. Root disease can be controlled by reducing the ratooning period, by improving preparation, cultivation and drainage, by the use of organic manures and of lime, and by rotation of crops.

The general evidence goes to show that it is in the fields that have had least attention in these matters and in fields naturally poor that the frog hopper finds the most suitable conditions for rapid multiplication. The admitted exception occurring in frog hopper years, in which some good fields may be attacked, may very well be due to migrations of the pest from fields in worse condition.

The practice of throwing out fields to grass, especially when the old stools are left to sprout, is definitely bad with reference to both frog hopper and root disease (as well as all other insect and fungus diseases of cane). It should be an invariable rule to plough out as soon as possible stools not intended to be cultivated as ratoons. It is highly desirable that in addition to this a cultivated crop not belonging to the grass family should be grown.

It is our conclusion that well-considered application of the measures referred to above, i.e., the reduction of the ratooning period, improved preparation, cultivation, and drainage, the use of organic manures and lime, and the rotation of crops, will give the best protection available against the development of frog hopper infestations, will greatly reduce the direct effects of such an infestation when it occurs, and will remove the serious contribution now made by root disease to the final condition of blighted fields.

Report on Sugar Manufacture and By-Product Utilization in Hawaii.

MR. ANDREW ADAMS, Chairman of the Committee on the Manufacture of Sugar and the Utilization of By-products, issued an interesting annual report to the Hawaiian Sugar Planters' Association last September, a summary of which is as follows:—

“The visit of the representatives of Crockett Refinery to the islands called renewed attention to two important units in sugar manufacture, the value of which has been emphasized by all good sugar manufacturers for years, namely the clarification of the juices and the boiling of low grade massecuites. Mr. PECK has made a series of experiments to show the influence of fine particles of *bagacillo* on the purity of the juice on heating; while Mr. WALKER and Mr. PITCAIRN have also expressed their opinion on these matters.

“It seems that we cannot place too great emphasis on the value of a proper grain, both as to size and to composition, in the low grade massecuites so as to get a high purity melt from the resulting sugar. Incidentally, of course, there would result a low purity final molasses, which is desirable. But another very important result would be the elimination of low grade molasses, as far as possible, from the process; and the fact remains that the return of a quantity of low grade molasses in the low grade melt has a very disastrous effect upon our raw sugar.

“When we realize that Javan and Cuban sugars contain from 0.30—0.35 of ash and from 1.25—1.75 of invert sugar, we can easily understand how our Hawaiian sugars in general do not meet with favour at the refineries because of their very high percentage of ash. It is my conviction that if we improve our clarification by removing from the juices the fine particles of *bagacillo* before the juices have been heated, and improve the quality of the low grade sugars for

returning to the process, the ash content of our commercial sugars will be decreased and better returns without material increase in the cost of manufacture will be realized.

"The desirability of obtaining a final molasses of low purity is perfectly obvious when we consider the volume of this by-product annually sold either as such or discarded as a waste. At the time of writing this report, molasses figures for 1920 are unavailable. During 1919 the Hawaiian factories produced 601,710 tons of sugar and 153,521 tons of final molasses, which is slightly in excess of one ton of molasses for every four tons of sugar bagged. It appears that this molasses had a gravity purity of 38.07. Therefore the molasses contained 50,884 tons of sucrose, which was one ton of sucrose for every 11.75 tons of sugar bagged. If the gravity purity of our final molasses had been 24 instead of 38° in 1919, we should theoretically have reduced the amount of sucrose in final molasses by 18,786 tons; and, assuming an 80° purity melt, and 82 per cent. recovery and a 97° sugar we should have increased our production by 15,890 tons of commercial sugar. Even if an exhaustion of 24° cannot be reached, the fact remains that for every degree downward from 38° final molasses we could have saved 1135 tons of commercial sugar. Had we reduced it 1° at this year's price, we should have sold the 1135 tons of recovered sugar, as sugar, for \$215,650, instead of selling the same 1135 tons of recoverable sugar as molasses, for \$36,456.

"To get a better recovery of sugar means, with other equipment, more pans and more crystallizers. The type and, possibly, the dimensions of the crystallizers have great influence upon the recovery. At Kahuku there are four different dimensions of crystallizers, all of the enclosed type. In one set the diameter is 7 ft., and there are outside jackets or shells for water circulation. The remaining sets have no shells, and their diameters are 7 ft., 6 ft. and 5 ft. All have the same type of stirrers, and all stirrers revolve at the same rate of speed.

"During the season of 1920 records were kept of 151 crystallizer strikers of massecuite, and of the final molasses resulting, the following table showing the results. A pan-masse purity ranging from 52.5 to 53.5 according to circumstances is the standard; dimensions are inside diameters; the crusher juice purity is of the day previous to that on which the strikes were boiled; and the drop is in points from purity of pan-masse to purity of final molasses. All purities given are apparent values.

Crystallizer Dimensions	Purity of Crusher Juice	Purity of Pan-Masse	Time in days	Purity final molasses	Drop of purity
5 ft.	82.99	52.58	14.10	29.13	23.45
6 ft.	83.34	52.43	12.10	29.13	23.30
7 ft.	82.77	52.31	11.64	29.42	22.89
7 ft. & shell ..	82.84	53.19	12.40	29.80	23.39

"In recent years there has been a continuous effort to increase extraction. With high purity juices an increased extraction has unquestionably resulted in a final greater production of commercial sugar per unit of cane. In some factories treating low purity juices, it is questionable if a high extraction has resulted in more than a slight, if any, increase in production of sugar; but it has resulted in a substantial increase in cost of production, as compared with the cost while obtaining a low extraction with the same quality of juices. This increased cost should include interest and depreciation on the cost of additional equipment made necessary throughout the factory because of the increase in extraction at the time of low purity juices.

"Profitable limits of extraction can be calculated with the known market value of sugar taken as one of the terms. This year at Kahuku there was a very

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noticeable drop in purity of the first expressed juice, and the extraction was allowed to drop from an average of approximately 97° to one of 95°. Coincidental with the drop in purity of the first expressed juice at Kahuku this year were two other phenomena. The first was an almost regular record of a syrup purity lower than the purity of the clarified juice, the difference amounting at times to 1.75°. The second was a great increase in the amount of undetermined losses. From clarified juice to syrup the juices were watched and frequently tested, with negative results of an explanation of the drop in purity. Eliminating entrainment, leaks, faulty weights and calculations, there was no accounting in the usual way for the undetermined loss, which finally accumulated to over three per cent. of the sucrose in the cane. Earlier in the season, when the purity of the first expressed juice ranged from 84-87, there was a rise in purity from clarified juice to syrup and the per cent. of undetermined losses on sucrose in the cane was normal. These observations have been made towards the end of every manufacturing season at Kahuku since high extraction has been the practice. They were especially pronounced this year when the season ended only during the second week in November.

"Three questions naturally follow. What is the cause? What is the effect? What is the remedy?

It is known that in Hawaiian canes there are present certain dextro-rotatory gums, dextran, for instance, which pass into the juice and cause an overestimate of the per cent. of sucrose in the cane. During heating and high concentration there is coagulation of some of these gums, the syrup reading then showing a drop in purity.

"An argument in support of the contention that high extraction influences the presence of these gums in the juices lies in the following: When the balance of the cane for this season had already been brought to the Kahuku mill-yard, there was an accident of such a nature that it was deemed advisable to grind the balance of cane without the use of the last mill; this was done, and there was grinding on parts of two days, extractions and purities being as follows:—

	Extraction.	Crusher Juice.	Clarified Juice.	Syrup
1st day	87.86 ..	75.08 ..	73.36 ..	74.40
2nd day	85.86 ..	73.86 ..	72.29 ..	72.88

"With an extraction considerably below 90° there was a gain in purity from clarified juice to syrup, even with the very unusual low purities recorded.

"Whatever may be the cause of the presence of these gums in the juice, it is certain that they are not sugar and that they are harmful. Under ordinary conditions of manufacture some of these gums are carried through the process and are shipped to the refineries. They decrease the value of our sugar for refining purposes and, therefore, ultimately its selling price.

"These are additional reasons why there should be an improvement in the clarification of the juices and in the production of low grades to be melted back into the process."

It is reported that the Ministry of Agriculture are about to undertake the manufacture of lactose (milk-sugar) from whey, a by-product in cheese making.

According to Edgar Tripp & Co., active preparations are being made in Trinidad to further the present sugar crop. Unfortunately in certain districts the destruction caused by the froghopper and the Mosaic disease has been extensive; nevertheless a fair average output is looked for. The shipments for 1920 were 49,000 as compared with 39,000 tons in 1919. During both years 17 per cent. of the total production was reserved for local consumption by order of the Food Board.

Suggestions on the Production of a Better Raw Sugar.¹

By S. S. PECK.

In previous reports, frequent references have been made to the relative refining value of Cuban and Hawaiian raw sugars,* as the result of which reports, a pronounced improvement in one respect has been made in the quality of our raws, viz., size of grain. This has been of decided benefit to the refinery at the affination station; but the fact still remains that sugars, such as Cuban, Philippine, and Peruvian, lend themselves to more easily mechanical handling in the refinery than do ours. A very brief description of this first stage of refinery operations may help to make this statement clearer.

The raw sugar after discharge from the bags is mixed in a mingler with affination syrup to a magma of about 90° Brix; separated in centrifugals; and washed with the required amount of water, giving a washed sugar of 99° purity and a syrup, known as affination syrup, of 70° Brix and 80° purity.

Washed Hawaiian sugar in general works as well as Cuban sugar. The exception may be noted when the raw sugar is made on low grade seed and contains dark seed grain which persists into the melt.

Affination syrup is a dark, viscous liquor. Part of it is used for mixing with new raws as above, the excess due to the water used in washing in the centrifugals, being mixed with "filter-cel" and filtered through Sweetland presses. The melted wash sugar is also filtered in this manner after "filter-cel" addition; but seven times as much filtering area is required for the filtration of the affination syrup as for the melted washed sugar, per unit of each handled. That is, the 80° purity liquor is seven times more difficult to handle than the 99° purity melt. It may be argued that the purity is sufficient to account for this difference; but it is a fact that for affination syrup from foreign sugars a much lower proportion exists. After filtration this affination syrup is passed through three filtrations in the bone-char filters, rising 10 points in purity with sufficient decolorization to give one strike of granulated sugar.

Any improvement in the raw sugar which would make for a more rapidly filtering affination syrup would be a distinct advance in refinery operations.

It would appear that there are two methods possible for attaining this object: the first would be the production of a raw sugar of a higher polarization. This would reduce the amount of affination liquor to be handled, while the quality of the molasses surrounding the raw crystals would be better inasmuch as it would have been "processed" less frequently. Impurities, such as glucose, ash, and gums, would be in about the same relative proportion but in lesser amounts. The advantage here would be due practically entirely to the lesser amount of these impurities to be passed through the filters. The second method would be the production of a better raw sugar. In my opinion, this can be obtained through earnest efforts directed toward the handling and treatment of the juice before it enters the evaporators as syrup. I beg to offer a few suggestions on this subject with the object of opening a discussion rather than of stating any final conclusions.

JUICE STRAINING.

At present the raw juice is strained through screens of relatively large size. In a determination made in the laboratory of Kahuka plantation, raw juice

¹ Report presented to the Committee on the Manufacture of Sugar and Utilization of By-Products, appointed by the Hawaiian Sugar Planters' Association, September, 1920.

² *I.S.J.*, 1917, 482.

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strained as usual was passed through a continuous 60-mesh screen, and dry *bagacillo* amounting to 0.17 per cent. on the weight of the juice was removed. This would mean in a factory grinding 1000 tons cane a day with 120 per cent. juice on cane, 2.1 tons of dry *bagacillo*. As this would be almost entirely caught in the presses and come out as press cake with 70 per cent. moisture, this would amount to 7 tons of press cake a day. Another experiment with a 100-mesh screen removed 0.24 per cent. dry matter, corresponding in a 1000 ton plant to 2.88 tons dry and 9.6 tons wet "cush-cush."

The removal of this additional suspended solid matter would affect the subsequent operations of the factory in possibly two ways as follows:—

1. *Effect on Press Cake.*—It is contended by many sugar boilers that if more fine trash is removed by finer screening at the mill there will be greater difficulty in getting a good press cake and washing the sugar out of it. This is an open question. Several factories have put in finer screens at the mills without affecting the filter press work. Others reported after the installation of the Searby shredder a considerable increase in the weight of the cake without any evident improvement in its quality. One factory had trouble in its press cake work, and attempted to correct it by adding additional fine bagasse without any beneficial results. This does not prove that there are not instances where the removal of a large percentage of fine trash might interfere with the making of a good cake; but indicates that there are cases where its absence would not interfere with this operation. The direct advantage can be figured out approximately as follows: A factory grinding 200,000 tons of cane a year would produce about 5000 tons press cake. At 1.34 polarization, 67 tons of sucrose are lost. Figured at 70° purity juice in the cake and a 38° molasses, there would be 52 tons of 96° sugar lost. If as in the calculation above, straining through a 100-mesh screen would remove 38.4 per cent. on the weight of wet cake, there would be a saving per crop of 20 tons of shipping sugar, worth at 10 cents, \$4000. Providing the cake works equally well, there will be a further economy in labour, filter-press cloth, and water to be evaporated.

2. *Effect on Quality of Sugars.*—The fine suspended matter in the raw juice is mainly cane fibre. The term fibre is a general one, and indicates the matter in cane not soluble in water. It varies in composition depending whether it comes from the rind, pith, or fibro-vascular bundles of the cane, and consists principally of cellulose, pentosans and lignin, both the latter being soluble in alkalis. Even the pith cellulose, according to BROWNE, is attacked by concentrated alkalis. The pentosans form gums, and the lignin is that which imparts the yellow coloration on digesting fibre with alkaline solutions. In making paper from bagasse it is necessary, in order to get a good product, to separate the pith from the rind fibre. According to work done at the Hawaiian Sugar Planters' Association Experiment Station, the pith fibre constitutes about 45 per cent. of the total cane fibre. The condition is thus presented of a material subjected to the solvent action of heat and sometimes alkaline condition of liquor, in a finely divided condition where the rate of solution is increased.

In order to determine this point, experiments were conducted at Kahuku plantation. It was found that where fine trash was present during clarification, there was a very decided increase in the amount of soluble gums present over tests where this was removed, the screening being through a 100-mesh screen; and that the less the acidity, the greater was the solvent action. It is very possible also that the purity of the liquor has an effect, but this point was not established. Three experiments gave the following results:—

	I.	II.	III.
Acidity	2.0	2.9	9.0
Gravity Purity	74.9	63.2	82.6
Per cent. increase on 100 Sucrose.			
Gums.. .. .	46.7	55.6	15.7
Ash	5.5	8.5	—

In these experiments boiling during clarification lasted one minute, and the juice was filtered at once. If the time of exposure to the action of the solvent were longer, as in the usual sedimentation; and if there had been a possibility of further solution, as during the liming and sweetening-off of the press cake, the differences would probably have been greater.

A further condition, not determined, was the action on the colouring matter in fine fibre from coloured canes. It is most probable that an important amount is thus extracted.

That these fine particles are acted upon in some such manner during clarification can be easily seen by melting raw sugar and screening through a fine screen. On the screen will be found gelatinous looking particles, which are nothing but cane fibre in a partially hydrolysed form; during the hydrolysis, part of the constituents have entered into solution, and persist through to the final products, sugar and molasses.

The total amount of these gums present is small. In the tests referred to they were 2.0, 4.9, and 1.3 per cent. on sucrose respectively, increasing to 3.0, 7.7, and 1.55 per cent., due to presence of fine trash. But the influence of such impurities is important. Among the impurities which make for turgid boiling, poor drying, and slow filtration, the gums and the organic lime salts play the most important rôles. A decrease of 47 per cent. in the former is therefore well worth the effort. As an example, a molasses of 90° Brix, 37° gravity purity, 20 per cent. moisture, 15 per cent. glucose, and 12.7 per cent. ash would contain 19 per cent. organic non-sugars. Taking the first experiment, these organic non-sugars would consist of 19.7 per cent. gums when the fine trash had been removed, and 28.9 per cent. when they were present during clarification. It is submitted that while the content of gums in the latter case is 147 per cent. of that in the former, the relative viscosities are in considerably greater proportion.

In the case of the final molasses in the refinery, approximately the same conditions will obtain; but due to elimination by the char filters of impurities in different proportions the end results will not be exactly the same. However, the molasses in the affination syrup is our raw sugar molasses, and can be compared. Its viscosity will be reduced by such a procedure as outlined above in proportion to the action of the gums not included in the molasses. A very approximate calculation shows that in an affination syrup under present conditions the gum percentage is 1.36, which might reduce to 0.93 with the fine trash removed. Again it would seem that such a small difference could affect the rate but slightly, yet laboratory tests have shown that sugar of different marks, but of the same purity, operated under identical conditions, will filter at widely different rates, demonstrating the presence of some retarding substance. As the experiments were conducted on solutions of 97.5 purity, these substances were naturally present in very small proportion, yet they exerted a profound effect on the rate of filtration.

SEPARATE CLARIFICATION OF MILL JUICES.

Reference has been made to the procedure in reports published in preceding years. During the past year an opportunity was offered to analyse some of the products. It was believed that by dividing the juices, those of lower density and

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purity could with economy be given additional treatment to improve the quality. Addition of soluble phosphates or phosphoric acid was efficient, not only by removing soluble impurities, but it removed suspended matter by increasing the bulk and gravity of the precipitate. Tests giving results per 100 of sucrose showed as follows:—

Suspended Solids.	No Phosphoric Acid.	Phosphoric Acid.
Total.. .. .	7.97	0.64
Organic	6.86	0.57
Mineral matter	1.12	0.07
Gums	1.35	1.16

The difference in composition of juices from the different mills after clarification is shown in the following tests, in which phosphoric acid was used on the second mill juice only, these being also stated per 100 of sucrose:—

Suspended Solids.	1st Mill and Crushed Juice.	2nd Mill Juice.
Total	0.048	0.389
Organic	0.046	0.356
Gums	0.188	0.600
Ash	4.45	6.64

It is submitted that if these juices had been clarified together in the usual manner, the mixed juice would have contained a larger percentage of suspended matter and gums than results from separate clarification and phosphoric addition to the diluted juice, and to this extent improved the working quality of the raw liquor.

USE OF FILTER AIDS.

Until recent years, the regular refinery practice was to treat the melted washed raw sugar with phosphoric acid and lime, producing a precipitate of calcium phosphate, and filtering through bag filters. This practice has been supplanted by the simpler one of adding a definite amount of "Filter-cel," or kieselguhr or infusorial earth, to the melt, and filtering through closed filters such as the Sweetland. No chemicals are added with the occasional exception of a very little lime to correct acidity of the sugar. The filtrate is brilliantly clear and ready for filtration through bonechar, the "Filter-cel" removing entirely all suspended matter and possibly to a lesser extent the colloidal matter. This property of "Filter-cel" has been applied to raw factory operations, but has not been generally adopted.

The results of Dr. Zerban's recent experiments,¹ particularly with "Filter-cel" as the sole clarifying agent, opens up a new line of investigation which should be applied to conditions in the Hawaiian Islands. If it is the colloids which form the deterrent factor in good recovery and superior sugar, and it is found that their removal prior to the application of heat is practical, a great step in advance will have been taken in the improvement of our sugars. In further reference to the removal of the finely divided particles of cane fibre, this in itself may diminish the colloid content of the subsequently clarified juice. A description of methods of screening and apparatus forms a part of the report of the Committee on Manufacturing Machinery.²

The report of the East India Distilleries and Sugar Factories Ltd., for the year ending September last showed a profit of £59,969, after paying interest on and providing for the redemption of the debenture stock. A dividend of 8½ per cent. has been paid on the preference shares and the ordinary shareholders received a dividend of 13½ per cent. Of the balance of £33,492, the directors placed £20,000 to the general reserve and wrote £10,000 off the amount standing to good will, carrying forward £3492.

¹ *I.S.J.*, 1920, 332, 699.

² *I.S.J.*, 1921, 90-92.

The Comparative Values of Decolorizing Carbons

By F. E. THOMAS, M.A. (Oxon), A.I.C.

Some twenty years ago the chief, and one may say, the only decolorizing agent in general use in sugar refineries was bone char. The bone char industry was in the hands of comparatively few firms, and the raw material was invariably the same. The consequence was the production of a char which was, on the whole, uniform in its decolorizing power. Moreover, bone-char, being one of the least valuable of the substances which can be obtained from bones, themselves a fairly cheap raw material, was comparatively low in price, and a slight variation in its carbon content and its adsorbing power was not regarded as serious enough to require compensation. The bone char system has held the field very nearly long enough, and is gradually becoming regarded as out-of-date even by its supporters, who still cling to it in most cases owing to the money which they have sunk in bone char plant. The rise to importance in the last ten or twelve years of decolorizing carbons has been so marked that we are not making a new prophecy when we say that in our opinion in ten years time much more sugar will be refined by decolorizing carbons than by bone char. The industry of making decolorizing carbons is at present in its infancy, and it is to certain aspects of this manufacture that we wish to call attention.

All new industries must inevitably result in much research with the consequent publication of a considerable amount of literature dealing with the points raised. These papers are usually not co-ordinated; contradictory statements are made, and a lot of time wasted in argument between workers in different parts of the world, who are all, perhaps, perfectly correct in their statements, but who obtain different results inasmuch as their premises are not identical. This has been the case with the industry in question. The interest which has been aroused has shown itself to be world wide. It has been largely purely scientific—such researches as those of ZERBAN¹ and BOCK² in America, and BRADLEY³ in this country may be mentioned—and a great deal of spade work has been done, many very useful and interesting facts having been elucidated. It has also been commercial, patents having been taken out by workers in a large number of countries for carbons prepared by quite a number of different methods. A lot of practical work has been done with a view to finding the optima conditions for successful manufacture and manipulation of carbons, and the reasons why certain carbons are better than others. But there is one point which has not been given sufficient definition. We refer to the question of a suitable method of comparing the decolorizing powers of the various carbons.

Incidentally, we may remark here that we think the subject has reached sufficient importance to be worthy of the support of some influential body of scientists to give the matter attention. The figures which have been published are, for lack of complete definition, in many cases misleading. What interpretation, for instance, is exactly to be placed on a statement that a carbon is twenty times more efficient than bone-char?

The present usual method of estimating the effect produced by a carbon is to read the colour of the solution in a tintometer or colorimeter before and after treatment with the carbon. At once an error is introduced. When using raw sugars, it is usually impossible to read a 50° Brix. solution in a $\frac{1}{2}$ in. cell, the size in which, as a rule, the clarified sugars are read. In any case the raw and refined syrups are hardly ever read in the same sized cell, the raw being read in a

¹ *J.S.J.*, 1919, 284; 1920, 90.

² *J.S.J.*, 1920, 709.

³ *J.S.J.*, 1920, 52; 1921, 25.

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smaller one and the units of colour multiplied by the number of times the cell used is smaller than that in which the decolorized solution is measured. Every chemist knows that it is the exception rather than the rule for a coloured solution in a $\frac{1}{2}$ in. cell to have exactly twice the colour units of the same solution in a $\frac{1}{4}$ in. cell. It is most unlikely to occur in the case of sugar syrups, the colour of which is due to several different factors. Therefore, all figures of "percentage of colour removed" rest on an empirical basis, which is known to be inaccurate.

If we assume that figures obtained in this way have a scientific meaning, let us see how investigators have used them for purposes of comparison. In the early days the tendency was to argue that if one carbon took out 80 per cent. of colour and the same percentage of another carbon took out 60 per cent., that the first was 20 per cent. more efficient or $33\frac{1}{3}$ per cent. better than the other. ZERBAN in his classical investigation into the preparation of vegetable carbons¹ says, in comment on this :—

"In this table we have added a further column, giving the efficiency of each carbon in terms of Norit. It will be shown in the discussion of the results that this carbon serves the purpose excellently. Norit, under the special conditions of our method removes 81 per cent. of colouring matter. Another carbon may remove, say, 96 per cent. This means that the second carbon takes out only 15 per cent. more than Norit, calculated on the quantity present in the original solution. But in using decolorizing agents the quantity remaining in the treated solution is of much greater importance than the quantity removed by the carbon. From this standpoint the second carbon cited above is not 15 per cent. more efficient than Norit, but $19\frac{1}{4}$ or 4.75 times as efficient as Norit since it leaves only 4 per cent. of colouring matter in the liquor as compared to the 19 per cent. left by Norit "

This is a big advance in the idea of comparing decolorizing powers, but it is not enough yet. Dr. ZERRAN goes on to say that Dr. BANCROFT has justly remarked about this method of expressing the efficiency of the carbons, that it gives an exaggerated idea of the actual adsorptive effects. There is more than that to be said about it. Scientifically, it is incorrect. An appeal *ad absurdum* demonstrates this. For if we assume that this method really does provide us with a comparative idea of decolorizing power, we are led to believe that a carbon which adsorbs 80 per cent. of colour and leaves 20 per cent. is only five times as good as a carbon which adsorbs no colour at all, that is, leaves 100 per cent., or again that a carbon which adsorbs 100 per cent. and leaves no colour is "infinity" times better than any other carbon which leaves the smallest particle of colour. No one will support such statements.

All such methods, therefore, which consist in comparing carbons by a comparison of relative amounts of colour removed from the raw sugar seem to the writer unsatisfactory, owing to there being, at present, no suitable way of giving the results a scientific quantitative interpretation. If we do not know all there is to be known about the colouring matters of sugar solutions, we do at any rate know that there is a large number of them and that their physical state varies, some being colloidal, and some not, some probably colour complexes, others of a simple nature. We certainly do not know what percentages of each of these colouring matters are adsorbed by varying quantities of carbons. Even if these are adsorbed to different extents by different carbons, we can, however, usually by varying the quantity of carbon, produce syrups which have very approximately the same tint.

This statement leads to another and it would seem a more practical way of regarding the matter. The manufacturer who buys a carbon now-a-days wants

¹ *Loc. cit.*

to know the "strength" of the carbon. He is not dealing with a more or less stable article like bone char; and if he is told that a certain carbon is six times as good as another carbon, it should and can mean only one thing to him, and that is that to get the same effect on the same material he would have to use six times as much carbon in one case as in the other. He is not interested in an analysis as to the amount of ash or carbon present; he buys his carbon at so much per ton, and it is on the article as delivered that he wishes to estimate its value in weight as compared with other carbons.

This view certainly has advantages; scientifically there can be little objection. The purpose of a large number of patents being presumably to market the carbons they deal with, it is obvious that it is commercially sound, because it tells the potential user what he wants to know. At present we are so apt to talk of such and such a carbon being such a tremendous price, while others are cheaper. Carbon at £150 per ton is better value than carbon at £20 which has only one-tenth of the decolorizing power of the first, as estimated in the way indicated. There may be objections to thus giving an absolutely correct scientific valuation; mass action must inevitably tend to exert an influence, but this would be in favour of the lower grade carbon. It is free from the disadvantages of the "colour removed" system, as it almost eliminates the personal equation in the colour matching on the tintometer.

According to ZERBAN,¹ one of his carbons was 32 times as efficient as "Norit"; this meant that where "Norit" takes out 84 per cent. of colour his carbon takes out 99.5 per cent.; but to the user of carbons this would rather imply that 32 per cent. of "Norit" takes out the same amount of colour as 1 per cent. of Zerban's carbon, and we do not suppose that this would actually be found to be the case.

There is another point which requires to be considered in comparing carbons. Given any carbon, we have no way of determining what percentage of the carbon is active and what percentage is not. It is possible by digesting carbon with strong sulphuric acid to get a small quantity of extraordinarily active carbon; to say its efficiency is 100 times that of "Norit" would in our opinion not be over-estimating it. If we assume this to possess an activity of 100 per cent., it is obvious that only a comparatively small percentage of the carbon in decolorizing carbons is fully active; and that by suitable treatment, such as repeating the process by which carbons were made, a treatment with suitable activating agents or the action of heat, the activity and efficiency of these carbons can be increased. For instance, the writer has in his possession a special "Norit" of at least 10 times the efficiency of ordinary first-grade "Norit," and this is sold in Holland for medicinal purposes. But, naturally the price of the carbon will increase the greater the number of treatments it receives; while also, owing to the losses involved, the second and subsequent treatments cost more than the first. In making his carbon 4 times as active as his original product, a carbon manufacturer will probably find that he cannot sell it under 6 times the price of the carbon he started from. The refiner, may therefore, expect to be offered carbons of various strengths at different prices ("Norit," for instance, being made in four different grades) and as different strengths are required for different refinements, it is necessary for the refiner to have some factor of efficiency which means something to him. Therefore, in all efforts to get better carbons, the cost of manufacturing the carbon is a matter of the greatest importance. The question for the research chemist is not "Can I make a better carbon?"; but "Can I do so at the price?" He can always make a better carbon—at a price.

¹ *I.S.J.*, 1920, 91.

The Comparative Values of Decolorizing Carbons.

If the method above recommended be regarded by those interested in carbons at large as an improvement, they will agree that some standard carbon is required. The number of well known carbons on the market is not large and the choice is somewhat limited. ZERBAN has taken "Norit" as his standard, and nearly all other workers have referred their carbons to it. It is a well known and a high grade carbon; it is available in most countries; its different batches show great uniformity in efficiency. We suggest that ZERBAN, BRADLEY and others be followed in adopting "Norit" as the standard. But it is also necessary that the experimental conditions be carefully observed. For example, the carbons should be taken as actually delivered by the makers; the sugar to be treated should be raw of not too low a grade (the nature of the sugar will vary naturally and one cannot lay down a hard and fast rule here); while it should also be specified that the density of the solution should be 50° Brix., and that it should be neutral on the acid side. One should work as nearly as possible to factory conditions. The solution obtained after treatment with 5 per cent. of "Norit" should be taken as standard. The maximum and minimum amounts of carbon that in practice would ever be used may be taken to be 40 per cent. in a continuous filter, or $\frac{1}{2}$ per cent. in a press. This gives us a range of carbons having an efficiency from one-eighth to 10 times that of "Norit." This should cover most carbons. If it does not, the standard solution can be varied by using say $2\frac{1}{2}$ per cent. or $7\frac{1}{2}$ per cent. of "Norit." A raw sugar solution is suggested, as in most cases the carbons are required to clarify as well as decolorize. The carbons should be added in the cold, brought to the boil in equal intervals of time, and filtered, the first half of the filtrate being returned to the original solution and filtered again to eliminate the fine particles which nearly always come through at the beginning. Very few experiments ought to suffice to effect an estimation, after which the comparison can be carried to as accurate a figure as may be desired.

Carbons have been prepared by very elaborate methods, and a high efficiency claimed for them. At the risk of being accused of labouring the point, the writer wishes to emphasize that such patents and methods are of very little use unless they result in the production of carbon that is lower in price than a carbon of equal efficiency on the market, or lower in proportion, i.e., having a higher "factor of efficiency" than other carbons. We cannot here go into certain essential features in the nature of carbons for use in the factory, such as speed of filtration, fineness, etc., and must assume these as being either the same or varying little from one another. But price and "factor of efficiency" are two necessary facts in talking of carbons, and if selling prices of new carbons be given with their strength as compared with "Norit" according to the method proposed, chemists will be assisting in reducing this new branch of physical chemistry to some sort of order; and also giving, not only to sugar manufacturers but to a number of other industries which use decolorizing carbons, information which will be of real value to them.

It was recently stated that Dr. F. J. BATES, of the Bureau of Standards, had used CLARK and LUNDS method for the determination of the hydrogen ion concentration in the case of refined sugars.¹ For the information of those interested, it may be mentioned that the indicators referred to are obtainable of the Central Scientific Co., of 460, E. Ohio Street, Chicago, U.S.A.; and that the most recent and exhaustive discussion of the entire subject will be found in a book by WILLIAM M. CLARK, entitled "The Determination of Hydrogen Ions," which we reviewed quite recently.² Several other papers have been published on this determination, which promises to be one of importance to those concerned with sugar analysis.³

¹ *I.S.J.*, 1920, 484-485.

² *I.S.J.*, 1921, 103.

³ *Journal of Bacteriology*, 1917, 2, Nos. 1, 2, and 3; *Ibid.*, 1920, 5, No. 2; *Phytophy*, 1919, 5, No. 4; *Biochemical Journal*, 1910, 5, 207.

An Inherent Error in Certain Modifications of the Clerget Method of Double Polarization.

By C. A. BROWNE.

Among the more recent modifications of the Clerget method for determining sucrose is the so-called neutral method of double polarization first proposed by SAILLARD¹ in 1912, at the eighth meeting of the International Congress of Applied Chemistry, in New York, and afterwards employed by JACKSON and GILLIS,² in their general methods for the analysis of sugar products. In this method the hydrochloric acid used in the process of inversion is neutralized with sodium, potassium or ammonium hydroxide before making up the solution to volume for the invert polarization. In order to equalize conditions, the equivalent amount of sodium, potassium or ammonium chloride is added to the solution for the direct polarization, the assumption being that, the conditions of the two polarizations being alike, the error of the ordinary procedure due to the action of the acid upon the rotation of invert sugar, amino acids, etc., can thus be eliminated.

In recent experiments with this modification of the Clerget method upon known amounts of sucrose and upon mixtures of sucrose with other constituents, made by the writer and his assistants, G. H. HARDEN and C. A. GAMBLE, it was found impossible to obtain concordant results. A closer investigation of the question revealed the presence of an inherent error which renders this method of analysis subject to serious criticism.

In order that the effect of the addition of a fixed amount of sodium, potassium or ammonium chloride upon the polarization of a sugar may be calculated, it is necessary that the exact concentration of the salt in the water of the 100 c.c. of sugar solution be known. A concentration of 5 gms. of sodium, potassium or ammonium chloride in 100 c.c. of a solution containing different amounts of a sugar is not, however, a constant concentration in its physical chemical effects, as the advocates of the method of neutral polarization seem to assume. The amount of water contained in 100 c.c. of a 50 per cent. sugar solution is obviously less than that contained in a 5 per cent. sugar solution. The concentration influence of the accompanying 5 gms. of salt will be greater, therefore, in the 50 per cent. solution than in the 5 per cent. solution; and its effect upon the rotation of the accompanying sucrose, invert sugar, etc., will be correspondingly greater. That this is so can be seen from the following experiments upon the polarization of solutions made up with varying amount of sucrose and fixed amounts of ammonium and sodium chlorides. The concentrations of the latter were 3.392 grms. ammonium chloride and 2.315 grms. sodium chloride in 100 c.c. of solution, these quantities being the same as those used by JACKSON and GILLIS in their method of procedure.

A Gms. Sucrose in 100 c.c. of Solution	B Polarization in presence of 3.392 grms. of NH ₄ Cl.	C. Polarization B calculated to 26 grms. in 200 mm. tube	D Polarization in presence of 2.315 grms. of NaCl	E. Polarization D calculated to 26 grms. in 200 mm. tube.
52 (100 mm. tube) ..	99.05	99.05	99.00	99.00
26 (200 mm. tube) ..	99.40	99.40	99.35	99.35
20 (200 mm. tube) ..	76.53	99.49	76.45	99.39
13 (200 mm. tube) ..	49.78	99.56	49.75	99.50
5 (200 mm. tube) ..	19.17	99.68	19.15	99.58

It is noted that as the amount of sucrose in the 100 c.c. diminishes, and the corresponding amount of water increases, the action of the dissolved salt upon the

¹ *Communications, Eighth International Congress of Applied Chemistry*, Vol. 25, 541; *I.S.J.*, 1912, 578; see also *I.S.J.*, 1914, 39.

² *Scientific Paper of the Bureau of Standards*, No. 375: *I.S.J.*, 1920, 509, 570, 638.

Modifications of the Clerget Method of Double Polarization.

rotation of the sugar becomes correspondingly less and the values in columns C and E approach 100, the true rotation of sucrose. The fixed values of sucrose + 3.392 grms. NH_4Cl = + 99.43; and of sucrose + 2.315 grms. NaCl = + 99.38, employed by JACKSON and GILLIS as the positive constituents in their evaluation of the Clerget divisor are true, therefore, only for a concentration of 26 grms. sucrose in 100 c.c., and not for greater or smaller amounts than this.

The observations made for sucrose-salt mixtures hold also for invert sugar-salt mixtures and for sucrose-invert sugar-salt mixtures, the particular value of the positive and negative constituents of the Clerget divisor varying with the amount of water present with the fixed amount of salt in the 100 c.c. of solution. While it is possible to establish a set of factors for pure sucrose alone in this method of procedure, the complication of variables makes it difficult to determine the exact Clerget divisor for the mixtures of sucrose, dextrose, levulose, gums, and other organic substances present in impure products.

The only method of double polarization which is free from the objections named is the invertase method, and it is hoped that stable commercial preparations of this enzyme may at some time be supplied to the analyst. Until this is done, the determination of sucrose in miscellaneous mixed products by the various methods of double polarization can be regarded at its best as only a more or less satisfactory approximation.

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Correspondence.

BAGASSE CARBON.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

SIR,—In your January number (page 54) you give, under your "Review of Recent Patents," an extract from German Patent No. 322,135, of June 17th, 1920, granted to Mr. JOHANN N. A. SAUER, of Amsterdam, Holland. In this extract it is stated:—"This invention provides a preliminary treatment with a relatively small quantity of a cheap carbon made by dry-distilling bagasse or beet pulp in closed retorts, the addition of which to the juice removes a large amount of organic and inorganic substances, though little of the colouring matters. After use, the spent carbon may be mixed with the bagasse going to the furnaces."

Permit me to state that as far as bagasse is concerned, this invention has been anticipated by my U.S. Patent No. 455,675, of July 7th, 1891, on the Purification and Manufacture of Sugar, of which I enclose a copy. This patent has been public property for about 13 years, and describes the use of bagasse meal, crude or charred, and of other materials, in practically the same way as Mr. SAUER describes in his patent. In Bulletin 167, of May, 1919, page 40, of the Louisiana Sugar Experiment Station,¹ Dr. ZERBAN stated that I was the first who proposed the use of bagasse char for filtering purposes.

By comparing the two specifications mentioned above, you will probably come to the conclusion that Mr. Sauer's claims for the use of bagasse char as a filtering medium are void.

Yours truly,

MORIZ WEINRICH.

New York, February 19th, 1921.

¹ *I.S.J.*, 1920, 92.

Publications Received.

Technical Chemists' Pocket-Book. By Robert Ensoll, F.C.S. Fcap 8vo.; 31 illustrations; 204 pages. (E. & F. N. Spon, Ltd., 57, Haymarket, London, S.W. 1.) 1920. Price: 8s. 6d. net.

This is a complementary volume to Bayley's well-known "Chemists Pocket-book"; but whereas that valuable work of reference has been compiled mainly for the analyst, the present volume contains tables and data principally for the use of the works' chemist and manager. On the whole, the information appears well selected, and to be sufficiently comprehensive. Thus, from the point of view of the sugar factory technologist it is to be noted that there are notes and tables relating to the calibration of rectangular and cylindrical tanks; thermo-chemical data; furnace construction and efficiencies; combustion data; mechanical draught; generation and distribution of steam; steam boiler data; distribution of electrical energy; engine efficiencies; dimensions of w.i. pipe fittings; strength of materials; specific gravity tables; etc., etc. A very full index is provided, and altogether we think that this compilation will be found valuable by works' chemists, one that is likely to prove as serviceable in the works as "Bayley" is at the present time in the laboratory.

Colloidal and Crystalloidal States of Matter. Dr. Paul Rohland. (Constable & Co., Ltd., London.) Price: 4s. 6d. net.

This small book was published in 1911 for the purpose of directing attention to the scientific and technical importance of the colloidal state of matter. Although it is written in a semi-popular style, and its treatment of many important points is certainly scanty, it is nevertheless a work of some value to the chemist desiring to acquire a general knowledge of the important subject of Colloid Chemistry. Its purpose is mainly to show the importance of the colloid state in every branch of technology, and to indicate the direction of study by which fruitful results may be obtained.

(1) **A First German Course for Science Students.** (2) **A Second German Course for Science Students** Prof. H. G. Fiedler and Prof. F. E. Sandbach. (Oxford University Press, London and New York.) 1920. Price: (1) 4s. 6d., and (2) 3s. 6d., net.

Technologists connected with the sugar industry desiring to acquire a sufficient knowledge of German to enable them to read scientific literature in that language will find these two volumes of great service. There are, of course, many existing German science readers; but generally speaking these assume a previous acquaintance with the language, and do not profess to provide a systematic course of grammar, as do these excellent books of Profs. FIEDLER and SANDBACH. In the first of them, a systematic scheme of German accidence has been provided, each reading space being designed to illustrate more especially the sections of grammar referred to at the head of the passage, while moreover the most important rules have been gradually explained. In the second volume, a selection of extracts from recent German chemical and physical literature has been collected, and arranged in order of difficulty. We have pleasure in recommending this German Course. After working through the two volumes, we consider that the student will be in a good position, with the aid of a suitable dictionary (as that published two or three years ago by Dr. PATTERSON,¹ formerly editor of *Chemical Abstracts*), to take up the perusal of articles published in the German technical press, for example, the *Zeitschrift des Vereins der deutschen Zucker-industrie*, or any of the several others dealing with our subject.

First Course in Nomography. S. Brodetsky, M.A., B. Sc. (Leeds University.) (George Bell & Sons, Ltd., London.) 1920. Price: 10s. net.

¹ "A German-English Dictionary for Chemists." AUSTIN M. PATTERSON. First Edition. (Chapman and Hall, Ltd., London.) 1917.

Review of Current Technical Literature.¹

CORRECTION FOR THE INFLUENCE OF SUCROSE IN THE DETERMINATION OF REDUCING SUGARS BY FEHLING'S SOLUTION. *C. A. Browne. Journal of the Association of Official Agricultural Chemists, 1919, Vol. III, No. 2, 261-263.*

In his report as referee of the Committee on Sugar, appointed by the A. O. A. C., Dr. BROWNE said that he had made a detailed study of methods for the determination of small quantities of reducing sugars in the presence of large amounts of sucrose by means of Fehling's solution, under which conditions (as is well known) the disaccharide undergoes a slight hydrolysis or decomposition, producing substances which reduce the alkaline copper reagent. He has already shown² that the amount of copper reduced by sucrose is directly proportional to the weight of sucrose, and inversely proportional to the weight of reducing sugars present. This reducing action was found in the case of cane molasses, syrup, and similar products not to be expressed exactly by the quantity $\frac{S}{G}$, but by the modification

$\frac{S}{G + \frac{S}{a}}$, in which S represents the mgrms. of sucrose by CLERGET; G , the uncorrected mgrms. of glucose corresponding to the weight of reduced copper, and a , an analytical constant unchanged for any given method. If Allihn's method is used, the value of a is 40.

Curves plotted for a wide range of values using the formula $\frac{S}{G + \frac{S}{40}}$ begin to deviate from actual results obtained by analysis when the sucrose approaches very large amounts and the reducing sugars very small amounts. Concentrations of sucrose up to 9 grms. in 25 c.c. show an increase in reducing action; between 9 and 15 the reducing action is approximately constant; and with amounts exceeding 15 the action undergoes a decrease. This decrease may be due, as MAQUENNE has suggested, to the formation of complex sucrates of copper and potassium, the coefficient of dissociation of which decreases as the sucrose content increases³; but in Dr. Browne's opinion it is due to the excess of sucrose holding a part of the reduced cuprous oxide in a state of colloidal suspension. While it is impossible to establish any simple numerical relationship between the reducing power of sucrose and invert sugar for all concentrations, it is possible to do this algebraically for as high concentrations as are necessary in ordinary analysis. If it is desired to correct for the retarding influence of high concentrations of sucrose upon the reduction when using

Allihn's method, the formula $\frac{S}{G + 40}$ is modified to $\frac{S}{G + 40 + \frac{S^2}{1000G^2}}$. The quantity $\frac{S^2}{1000G^2}$ is negligible for amounts of sucrose less than 1 grm., but with amounts much above 1 grm., retardation in its reducing power becomes so pronounced that a correction must be made. A table is given in this article showing the application of the formula to the analysis of known mixtures of sucrose and dextrose.

DETERMINATION OF DRY SUBSTANCE BY THE REFLECTION REFRACTOMETER IN SYRUPS CONTAINING GRAIN. *Vlad. Skola. Zeitschrift für Zuckerindustrie in Böhmen, 1919, 42, No. 6, 294-304.*

In the refractometric determination of the dry substance of sugar factory products, it has hitherto been regarded as a necessary condition for accuracy that the drop of liquid placed between the two prisms should be free from crystals and solid impurities.⁴ This consideration holds for the generally used Abbe refractometer, in which the light from a mirror is transmitted through a layer (about 0.15 mm. thick) of the liquid under examination. During the past few years, however, the firm of ZEISS of Jena have put on the market an instrument improved by SCHÖNRÖCK,⁵ in which the light is either transmitted

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, I.S.J.)

² J. Amer. Chem. Soc., 1906, 28, 450.

³ Comptes rendus, 1915, 161, 617-623.

⁴ Deutsche Zuckerindustrie, 1908, 181.

⁵ Ibid., 1909, 103.

as in the former type, or else passes through a prism and is totally reflected from a layer of syrup. This latter arrangement was intended for use with very dark liquids; but it is pointed out that STANÉX and the author have found that it may be very conveniently applied to the determination of the dry substance of liquids containing crystals, for example, massecuites and molasses containing fine grain, the film of syrup between crystal and glass forming the reflecting surface. Experiments are now described demonstrating the reliability of this procedure in the case of mixtures containing 80 per cent. of crystals or 50 per cent. of fine grain. This total reflection refractometer is provided with a scale up to 85° Brix.

CALCULATION OF THE QUANTITY OF WATER TO BE ADDED TO BEET AFTER-PRODUCT MASSECUITES IN THE CRYSTALLIZERS. A. Grill. *Zeitschrift des Vereins des deutschen Zucker-industrie*, 1920, No. 777, 459-468.

Since the supersaturation of a solution of sucrose increases as the temperature decreases, it is often necessary to add a certain quantity of water to the massecuite in the crystallizers, this quantity depending upon the temperature, the purity and the density of the product concerned. In a previous communication¹ the author has published tables showing which density the mother-syrup² should possess for crystallization to the state of final molasses without any water addition, the temperature being 45° C., this table being compiled for a suitable range of true purity values. In the article before us, he has expanded these data (see the table), so that the density of the mother-syrup is stated in degrees Brix

Apparent Purity of the Mother-Syrup.	Temperature of Centrifuging.				
	35°	42°	45°	50°	60°
57	85.4	87.2	87.5	88.2	90.7
58	85.7	87.5	87.7	88.5	90.9
59	86.0	87.7	88.0	88.7	91.1
60	86.3	88.0	88.3	89.0	91.3
61	86.6	88.3	88.5	89.2	91.5
62	86.9	88.5	88.8	89.5	91.7
63	67.2	88.8	89.0	89.7	91.9
64	87.5	89.1	89.3	90.0	92.1
65	87.8	89.3	89.6	90.2	92.3
66	88.1	89.6	89.8	90.5	92.5
67	88.4	90.0	90.1	90.7	92.7
68	88.7	90.2	90.4	91.0	92.9
69	89.0	90.4	90.7	91.2	93.1
70	89.3	90.7	90.9	91.5	93.3
71	89.7	91.0	91.2	91.8	93.5
72	90.0	91.3	91.5	92.0	93.7
73	90.3	91.6	91.8	92.3	93.9
74	90.6	91.9	92.0	92.5	94.1

at five different temperatures at which centrifuging may be performed without any water being added to the massecuite during its period of cooling, the apparent purity and the Brix values being used instead of the so-called "true" purity and dry substances. It is seen by inspection of this table how the Brix of the mother-syrup varies while the purity is constant without the necessity of adding water. If, for example, on separating the mother-syrup from a massecuite the former gives a purity of 68°, then the correct Brix which should be carried is 90.2° when machining at 42.0°, or 91.0° at 50° C. If the temperature is 42.0° C., and the Brix of the mother-syrup is lower than 90.2°, then this mother-syrup is too thin; while if its Brix is above 90.2°, water must be added during the period of cooling in the crystallizers.

It is shown in this article how one may calculate the necessary amount of water to be added. If, for example, a beet second massecuite shows a Brix of 95.1°, a polarization of 72.0°, and a purity of 75.7°; and if these values for the mother-syrup are 93.4°, 64.5°,

¹ *Zeitschrift des Vereins*, 1913, 385-408

² By the "mother-syrup" is meant the liquid portion of the massecuite, separated by a suction-filter, laboratory centrifuge, or other suitable means.

Review of Current Technical Literature.

and 69.0 respectively; and if, again, the capacity of the crystallizer is 20 cub. m., or 30,000 kg., then applying Schneider's formula: $\frac{30,000 (72.0 - 64.6)}{100 - 64.5} = 6340 \text{ kg.}$, so that the amount of syrup is $30,000 - 6340 = 23,660 \text{ kg.}$ On reference to the table, it is found that a Brix of 93.4° with a purity of 69.0° is too high for any of the temperatures stated. Therefore, 100 kg. of the syrup must for a temperature of 35°C. be diluted to $\frac{93.4 \times 100}{89.0} = 104.9$; or 103.3 for 42°C., or 103.0 for 45°C., or 102.4 for 50°C., or again 100.3 for 60°C. Since the amount of syrup is 23,660 kg., the total amount of water to be added in the case of each temperature becomes 1160, 780, 710, 570, and 91 litres respectively. Lastly, in this article two other tables are presented in order to facilitate the calculation of: (1) The amount of mother-syrup in each cub. m. of massecuite; and (2) the actual water to be added in litres per 1000 kg. of syrup, given the Brix of the mother-syrup examined, and that of the mother-syrup read from the table on page 170.

DRY DISTILLATION OF EXHAUSTED BEET SLICES. *W. Parr and A. Starke. Zeitschrift des Vereins der deutschen Zucker-industrie, 1920, No. 777, 445-449.*

A Commission has been appointed in Germany to investigate the cause of the explosions occurring from time to time in beet slice drying installations, the Director of the Institut für Zucker-Industrie in Berlin presiding over this enquiry. It was observed by the writers of this paper that in drying fodder beets, gaseous products (among which methyl alcohol and furfural could be detected) are formed at 140° C., their weight amounting to about 13 per cent. On dry-distilling 200 grms. of exhausted slices in an iron retort, applying a final temperature of 500-600° C., 100 grms. of an acid liquid containing tar; 30 grms. of charcoal; and 29-30 litres of inflammable gas were obtained, that is, about 150 cub. m. of gas per 1000 kilos of slices, or approximately half the yield obtained in average practice from coal. This gas gave the following figures on analysis: carbon dioxide, 36.6; heavy hydrocarbons, 2.0; oxygen, 0.8; carbon monoxide, 16.0; methane, 20.9; hydrogen, 15.4; and nitrogen, 8.3 per cent. It burnt with a somewhat luminous flame; while when mixed with air it detonated, and in the presence of oxygen exploded quite violently. As in the dry-distillation of coal and wood, the gas coming over at the latter part of the operation contains more hydrogen than that evolved earlier. It seems, therefore, to be established that in the dry-distillation of exhausted beet slices a considerable quantity of combustible gas is produced, which on being mixed with air may easily give explosive mixtures. This fact, it is suggested, may very probably explain the frequent explosions occurring in slice drying, since the strong superheating of the product during the operation is not to be thought impossible.

OCCURRENCE OF SAPONINS IN BEET SLICES.¹ *A. Traegel. Zeitschrift des Vereins der deutschen Zucker-industrie, 1920, No. 777, 449-459.*

Neutral and acid saponins are known to be present in the beet,² their formation doubtless taking place in the leaf, from which later they migrate to the root. In the factory their presence became very obvious during carbonatation, owing to their extraordinary power of producing froth. Furthermore, these compounds possess strongly marked toxic properties, a characteristic which explains the death of fish in streams into which slice-press waste waters have been discharged, this effect being observed even when the dilution is one of saponin to 160,000 or 170,000 parts of water. According to experiments described in this paper, exhausted slices still contain a by no means inconsiderable amount of saponins. After having been dried, beet pulp was extracted with absolute methyl alcohol,

¹ Saponins are glucosides, that is compounds which on hydrolysis yield glucose together with one or more other substances, usually of an aromatic nature. Saponins are now known to be very widely distributed in the higher plants. They are amorphous colloidal bodies, which dissolve rapidly in water, producing a solution which when shaken forms a very abundant froth. They possess a very marked power of retaining dissolved gases, as carbon dioxide, and for this reason are sometimes added to soft drinks. Saponins are employed as substitutes for soap, having no deleterious effect on the colour or the fibre or the most delicate fabrics.—*Ed., I.S.J.*

² KOBERT, "Beiträge z. Kenntnis d. Saponinsubst." Stuttgart, 1904, page 48.

which solvent was later removed by distillation when a liquid dividing itself into two layers was obtained, the lower dark brown, thick and oily, and the upper lighter in colour and more mobile. Both were proved to contain saponins. Prof. MAGNUS, of the Landwirtschaftlichen Hochschule in Berlin, demonstrated in his physiological laboratory that this oily liquid had a strong haemolytic action, which was still more pronounced after the fatty and waxy impurities had been removed. It is intended to carry out further experiments to ascertain the relative quantity of saponins passing into the juice and remaining in the exhausted slices.

PRESERVATION OF SAMPLES OF BAGASSE IN THE LABORATORY. *Guilford L. Spencer.*
Journal of Industrial and Engineering Chemistry, 1920, 12, No. 12, 1197.

Commenting upon the results recently obtained in regard to the deterioration of bagasse, by LOOS and SCHWEIZER¹ on the one hand, and to the contradictory experiences of JANSSEN² on the other, Dr. SPENCER remarks that his experiments have indicated formaldehyde to be a fairly safe preservative for this material during short periods, say less than 6 hours, after which time some loss of sucrose occurs, probably due to its inversion by plant acids. A comparison was made between this method and that proposed and practised by the late HENRI PELLER, in which a strong atmosphere of ammonia is used. Cotton saturated with strong ammonium hydroxide is placed in perforated tin boxes at the top and bottom of the covered can containing the bagasse, the ammonia gas volatilized thoroughly permeating the material, neutralizing the acids, and imparting a yellow colour. Analysis is conducted as usual, excepting that no sodium carbonate need be added in the digestion, the precaution, however, being taken to acidify the extract with acetic acid prior to clarifying with basic lead acetate. In carrying out the comparative tests, finely comminuted bagasse containing about 3 per cent of sucrose was submitted to analysis (a) immediately; (b) after preserving with formaldehyde for 3 and 6 hours; and (c) after storage with ammonia during the same periods of time. In the formaldehyde test a loss was indicated after 3 hours, and a considerable one after 6 hours; while in the case of the sample saturated with ammonia gas the loss was 0.1 per cent. after 6 hours. These experiments are being continued, it being realized that the discovery of a reagent that will combine the qualities of neutralizing the plant acids and checking fermentation is very desirable. Some preliminary trials with vapour containing both ammonia and chloroform have given promising results.

REPORT OF THE NEW YORK SUGAR TRADE LABORATORY FOR 1920.³ *C. A. Browne*
New York Sugar Trade Laboratory, Inc., 50, South Street, New York.

Dr. BROWNE reports that, in addition to its regular routine, his laboratory has continued investigations on several problems. Observations have been made on the use of different type of saccharimeters,⁴ and on the testing of saccharimeters by the control tube⁵; while the results of other investigations on improvements in certain methods of sugar analysis and on the chemical and other characteristics of imported cane sugars are about to be published. A greater variation was noted in the raw sugars tested by the Laboratory during 1920 than during any previous year of its history. There was a marked falling off in the percentage of 96° test centrifugal sugars with a corresponding increase in the percentage of plantation white sugars testing over 98° and in the percentage of low-grade molasses and mat sugars testing below 80°. Notwithstanding the increase of 3.5 per cent. in the grades testing above 98°, the average polarization for the year under review was the lowest since 1915. During 1918, 1919, and 1920 the number of samples polarized was 16,283, 19,211, and 19,666, the average polarizations being 95.41, 95.55, and 95.09° respectively. Regarding the grades, 94-95° polarization formed 11.5 per cent. of the total; 95-96, 32.8°; 96-97°, 34.0; 97-98°, 5.6, and 98-100°, 3.8 per cent., the remainder being below 95°. The average number of bags making up a laboratory sample for 1919 was 1562, and for last year 1510.

J. P. O.

¹ *I.S.J.*, 1920, 169. ² *Ibid.* ³ For previous reports, see *I.S.J.*, 1917, 141; 1918, 331; 1920, 286.

⁴ *I.S.J.*, 1920, 331.

⁵ *I.S.J.*, 1920, 331.

Review of Current Technical Literature.

WEST INDIAN CROP CONDITIONS. *R. S. Cunliffe. Sugar, 1920, 22, 464-455.*

Some interesting details are given in this paper regarding the conditions in the sugar industry in the Lesser Antilles. The considerable drought in the earlier part of the year is discussed, especially with reference to Barbados and Trinidad. In the former island, BH 10 (12) again demonstrated its capacity of holding out under adverse weather conditions, whereas a number of ratoon crops died out. Emphasis is also laid on the fact that where careful preparations had been attended to, and liberal quantities of manure applied, the fields were much better able to withstand the drought. The natural protection of the surface against such dry seasons, of covering it with the dead leaves or trash, was applied wherever possible, but unfortunately there was considerable shortage in this useful substance. Generally, the young crop was suffering severely in Barbados and a number of ratooned plants had died out altogether. On the other hand, in all the islands harvesting and manufacture were being carried on without a hitch, whether in fully equipped modern factories, in those dependent on dried bagasse for fuel or even in the old concerns where windmills are still the motive power.

There would appear to be a considerable movement in the rearrangement and linking up of the smaller concerns so as to form larger estates with modern factories. The result of this, together with the high prices of sugar recently prevailing, has raised the value of sugar properties very considerably, and some remarkable figures are given by the writer to illustrate this tendency. Thus, in 1904, sales were effected of 404 acres for £5000 and of 284 acres for £2500, whereas recently 535 acres fetched £110,000 and 500 acres £120,000. This reminds one of the similar condition of affairs in the Lancashire cotton trade, and one wonders what the effect of the recent slump in sugar prices will be on these newly projected concerns. In spite of these upward tendencies, the writer draws attention to the fact that there is little increase in the output of sugar. This he regards as partly due to scarcity of labour, but more perhaps to the lack of sufficient attention to the improvement in agricultural practice, and he considers that the labour question is of less importance than the introduction and intelligent use of labour-saving machinery of a modern type. Meantime, the continued rush of labourers to Cuba may introduce a new and embarrassing factor in West Indian sugar estates. There is a marked increase in the production of syrups which at present are in great demand, and in many places the muscovado sugar is giving place to these. The French West Indian islands are also responding to the stimulus and with the foundation of the new experiment station in Guadeloupe, there is some prospect of more rapid progress; but the general state of the industry is very backward, as judged by the outturn of sugar per acre as compared with that in Barbados.

IMPROVED FURNACES FOR GUM MANUFACTURE *G. K. Kelkar. Paper read at the Seventh Indian Science Congress, Nagpur, 1920. Agricultural Journal of India, 1920, Vol. XV, Part V (September).*

This paper deals with the evolution of the cane furnace in the Central Provinces in India. The old time local furnace is described first, and then the introduced Poona furnace, and, lastly, a new one devised by the local Agricultural Department. It is claimed that the last named is as superior to the Poona furnace as that is to the old indigenous one. (1) The Central Province furnace consists of a hole in the ground, 4 ft. 6 in. deep, with a feeding hole 2 ft. \times 1 ft. 6 in. in front: the open pan is placed on the top. There is no draught, ash pit or exit pass for the smoke and hot gases. The time occupied in boiling is excessive and the fuel requirements enormous. Bagasse and trash are all used, and then wood is added, and after that any dried stalks available. (2) The Poona furnace has three main advantages: an ashpit, a draught passage and an exit hole for the smoke. The furnace is hour-glass shaped, the narrowest part being flush with the ground. The upper part, built up to 3 ft. 6 in. in height, is 7 ft. in diameter at the top and 3 ft. at the bottom, and the lower part, dug in the ground to 3 ft. 6 in., again expands to a diameter of 5 ft. At the junction of these two parts is fixed an iron plate with a central hole 9 in. in diameter: there is also a narrow pass from the ashpit 1 ft. 6 in. long at ground level. A feeding hole is provided in front 2 ft. 6 in. \times 1 ft. 6 in., and on the left of this is a

9 in. hole connected with a 6 ft. chimney for the escape of the smoke. The bagasse and trash are sufficient for boiling, thus saving 20 cart loads of wood and other fuel valued at Rs. 20 per acre. The juice boils in half the time and is of much better quality. (3) Furnace evolved at Sindewahi Farm. A shallow pit is dug 1 ft. 6 in. deep with sloping sides 6 ft. 6 in. wide at the top for a 7 ft. pan and 4 ft. 9 in. wide at the bottom. In the centre of this pit is a mud wall 1 ft. high with a passage at each end 6 in. wide for the mixture of the smoke and hot gas. The most important part is the grating, over which the fuel is fed and the draught obtained. This consists of $\frac{1}{2}$ in. iron bars, each 20 in. long, fixed at a distance of $\frac{1}{4}$ in. from each other to two end pieces of iron 1 in. broad. The size of the grating is 14 in. \times 20 in., and it is placed in a slanting position, so that a 14 in. space is left between its upper edge and the bottom of the pan for the feeding hole. A perpendicular cut is made from the lower edge of the grating, 1 ft. 6 in. deep, 15 in. wide and 3 in. long. In continuation with the upper edge of the grating flat stones are laid down for 3 ft., which cover the air passage and afford a place for the feeder to sit. A sloping passage 5 ft. \times 2 ft. communicates with the passage below the grating and provides a continuous draught for the burning bagasse. The outlet for the smoke and gases is at the side opposite to the grating, 15 in. \times 7 in., and is continuous with a passage 8 ft. long covered by stones or bricks, ending in a chimney 8 ft. high and 1 ft. \times 9 in. in section.

As compared with the Poona furnace the cost is small. With normal prices the new furnace can be erected for Rs. 5, whereas a *katcha* (rough) Poona furnace will cost Rs. 10 and, if bricked, Rs. 25. The bagasse is more than sufficient for fuel and all of the trash is available for digging into the soil: the writer states that this is equal to 30 cartloads of the local cattle manure and that the price of this is increasing by leaps and bounds. The feeding is usually the task of a strong man, being regarded as the most exacting part of the process, but in the new furnace it can easily be done by a small boy or girl. Boiling is much more rapid and, lastly, the heavy pan can be much more easily lifted to pour out the solidifying juice.

GUR MAKING FROM THE JUICE OF THE DATE PALM IN THE THANA DISTRICT OF THE BOMBAY PRESIDENCY. V. G. Patwardan. Paper read at the Seventh Indian Science Congress, Nagpur. *Journal of the Agricultural Department of India*, 1920, Vol. XV, Part V (September).

Gur is not made commercially from the date in the Thana district, and although there are countless groves of wild date trees along the coast comparatively few of them are tapped for toddy. There is thus a considerable opening for gur making, and this paper details the results obtained in a study extending over several years on this promising material. For the making of toddy there are two collections of the juice, the night collection called "nira" made before sunrise, and the day collection. While the latter is very readily fermentable and is the main source of the fermented toddy drunk, the latter, producing "sweet toddy," takes two days before it is fermented to the requisite degree. Nira is thus considered the most suitable for the making of gur: the juice readily sets to a solid crystalline mass with a dark brown colour, smells slightly of date juice and differs in taste from gur made from the sugar cane. The average production of gur is 10 per cent. by weight of the juice. In a good sample of juice 1.8 per cent. of glucose is present, but reducing sugars appear rapidly to the extent of 50-60 per cent. in ten hours. Two main lines of the experiment carried out are here referred to: (1) How to obtain the best nira for gur making and (2) how to get rid of the objectionable dark colour which is characteristic of date gur and so greatly depreciates its value in the market.

(1) The juice is collected each day in earthenware pots and the treatment of these has considerable effect on the character of the juice obtained and the rapidity of its fermentation. The following were the chief variations among numberless experiments. New pots were used and those already in use were smoked, coated with lime water, or treated with formalin (6 drops 40 per cent. per pot) or chloroform (10 drops per pot). The cut, exuding surface was carefully cleaned each day, the pots were put up late at

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night and taken down at 5 a.m. and the boiling was done at 7 a.m., all of these methods tending to prevent fermentation. The acidity was tested in each sample. Formalin proved to be the best preservative, although the acidity was not great in any of them. It produced a good, solid gur with a good grain: the rest did not form solid gur and the pots treated with lime water and sodium carbonate separately gave a dark, sticky mass.

(2) In 1918 a large number of experiments were made as to the relative advantages of the Bengal and Thana methods of gur making. The chief differences were that the cuts were shallow in Bengal and deep in Thana, the pots were smoked in Bengal after use and a rest of two days was given the trees after three days consecutive tapping. The Bengal methods were adopted with the exception of the shallow cutting. Pure juice was found to be amphoteric, clearly alkaline to methyl orange and acid to phenolphthalein. Good solid gur was, however, obtained by both the Thana and Bengal methods, but it had always the objectionable dark colour. The slight acidity of the fresh juice was found to change on boiling to alkalinity in reaction both to methyl orange and phenolphthalein, indicating the presence of an alkaline bicarbonate, and this was regarded as in the main responsible for the dark colour. Organic acids were chosen for rectifying this and a series of experiments were made with citric, acetic and tartaric acids. Citric acid was found to be the most useful. It gave a light and bright coloured gur with varying crystalline consistency. Acetic acid gave a good coloured gur but rather soft and sticky and with no good taste, while tartaric acid gave a solid crystalline gur with a deep red colour. Proceeding with the citric acid tests, it was found that, on adding before boiling one quarter of the strength needed for complete neutralization, a light, bright gur of good grain was finally obtained, fairly comparable with the best Poona yellow cane gur. For this 1 lb. of citric acid was needed for every 84 gallons of juice. The paper which is itself in the nature of an abstract, concludes with tables of analyses of gur treated in different ways and the effect of boiling on the alkalinity and acidity of the juice.

THE PRINCIPAL VARIETIES OF SUGAR CANE UNDER CULTIVATION IN BRITISH GUIANA IN 1918-1920. *J. B. Harrison. Journal of the Board of Agriculture of British Guiana*, 1920, Vol. XIII, Part IV (October).

Over a total of 67,488 acres the following out of a list of some 30 varieties were grown on areas over 1000 acres in extent:—D 625, 36,100 acres; D 625, mixed with Bourbon and other seedlings, 8651; D 145, 5183; D 118, 3608; B 208, 3118; Bourbon, 2926; D 419, 1887; Diamond 185, 1174. The average yields of these varieties in tons of commercial sugar were, in 1919:—D 625, 1.47; D 145, 1.51; D 118, 1.54; B 208, 1.29; Bourbon, 1.40; D 419, 1.42; Diamond 185, 1.36. Some varieties grown to a less extent gave better results, as follows:—Green Transparent, 1.57; D 167, 1.61; Java varieties, 1.72; B 6032, 1.67; B 6450, 1.93; B H 10 (12), 2.44; D 216, 1.88; while large scale field trials with other varieties again show considerably greater yields. It will be interesting to see how these develop when grown on the estates. The general trend appears to be in the direction of a gradual disappearance of Bourbon and the old varieties, as well as the existing Barbados seedlings, coupled with a great and continuous increase in the local seedlings raised at the Botanic Garden and Diamond and Providence estates. The Bourbon and the other old varieties have decreased from 17.2 per cent. to 8.9 per cent. during the last five years, while the local seedlings have increased during the same period from 73.3 per cent. to 84 per cent. over the whole planted area of British Guiana.

C. A. B.

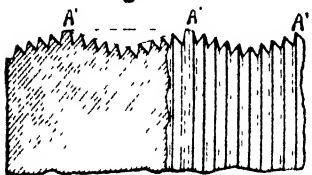
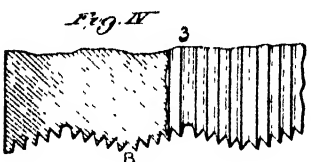
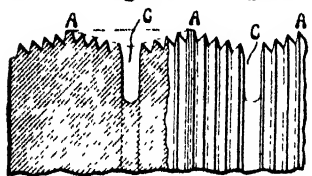
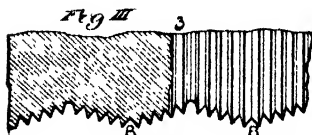
The sugar sub-committee of the British Empire Producers Organization recently reported on the prospects of sugar production in East Africa especially in the newly-named Kenya Colony. The areas here available divide themselves into two classes: coastal regions where irrigation would be necessary, and up-country districts where Natal types of cane could be grown under the existing rainfall assisted possibly by some irrigation. The chief problems are said to be the difficulty of obtaining labour from the large number of natives in the country, and the lack of adequate transport facilities. It remains to be seen whether practical measures can be taken to create a sugar industry in that colony, and the matter will be further considered by the B.E.P.O.

Review of Recent Patents.¹

UNITED STATES.

CANE MILL ROLLER WITH ARCHED CROWN SECTIONS. *Peter F. Hughes*, assignor to the *Cuban-American Sugar Co.*, of New Jersey, U.S.A. 1,227,145. September 15th, 1915; May 22nd, 1917. (Four figures).

All the rollers are preferably grooved or ribbed circumferentially; but this is not essential. Both the feed and delivery rollers may be provided with annular grooves *C*



extending toward the axis of the roller (as shown in figure III), into which the juice may flow for easy escape; nor is this arrangement essential, for the feed and delivery rollers may have the form shown in figure IV. What is claimed is the use of feed and delivery rollers formed with a succession of crown sections *A* throughout the length of the roller, the sections being arched longitudinally and the sides of the adjoining sections being in juxtaposition to each other, thereby forming circular valleys or gutters between the apex of one crown section and the apex of the next adjoining one. In the case of the top roller, there are crown sections *B* similar to those on the two lower rollers, but the arrangement is such that the crown sections oppose the valleys or gutters. Thus, the feed roller and the top roller and the delivery roller and the top roller have alternate convex and concave surfaces, the concave surface of one roller being directly opposed to the convex surface of the opposite one. When crushing cane, the expressed juice is permitted to flow, not only circumferentially of the feed roller, but also longitudinally along the crown sections *A* toward the bases of the gutters between the adjoining crown sections. Therefore, the juice collects in the gutters between the crown sections, forming rivulets having a much greater rate of flow than would thin films passing circumferentially of the roller. The grooves

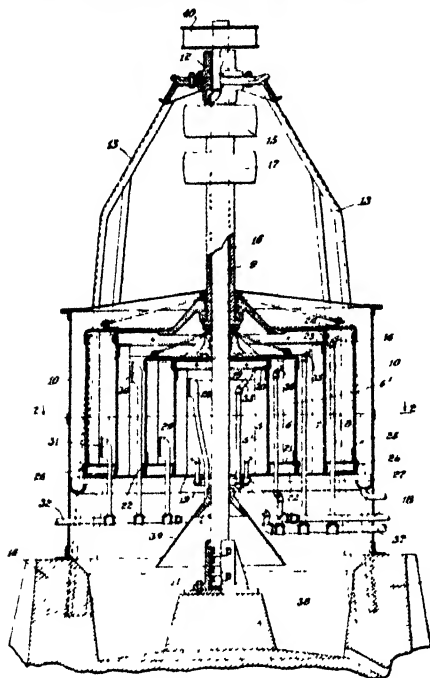
upon the crown sections, where such grooves are present, may become filled with cane, so that the juice may flow readily across the tops of the ridges between the grooves in their travel longitudinally of the rollers down the sides of the crown sections when escaping from the rollers.

CENTRIFUGAL CLARIFYING MACHINE FOR JUICES AND SYRUPS. *Antonio M. del Valle*, of New York, U.S.A. 1,350,009. August 16th, 1919; August 17th, 1920. (Two figures).

A machine is described which is said to be inexpensive, and capable of being operated economically and at high speed. It removes not only the solid particles, but also any scum which may collect. Further, it can be cleaned out quickly and thoroughly. It comprises a series of concentric cylindrical pans, 5, 6, 7, 8, all carried directly or indirectly by the vertical shaft 9, and surrounded by the casing 10. The two inner pans 5 and 6 rotate with the shaft 9 driven by pulley 15; while pans 7 and 8 are secured to the sleeve 16, driven by pulley 17. These pans are all closed at the top, but open at the bottom. The

¹Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

muddy juice or syrup is introduced into pan 5 through the pipe 18. This pan has a hollow flange 19 adjacent its upper edge which is shallower than the bottom flange 19 ft., and one or more passages and nozzles 20 is provided adjacent this narrower flange leading into



the pan 7. This pan has a flange 21 somewhat shallower than the bottom flange and a passage or passages 22 leading to the pan 7. The latter has a relatively shallow upper flange 23 and a passage or passages 24 leading to pan 8, which in turn has a relatively shallow flange 25 and a passage or passages 26 leading to the outer casing which is stationary and provided with a trough 27 from which the clarified liquid may be drawn off or removed. The flanges on the pans are in effect formed as if a hollow closed cylinder had relatively large apertures in the heads, the edges of the apertures forming the edges of the flanges. The plates, 6 ft., 6 ft., etc., assist in keeping the liquid and the precipitate moving with the pans and prevent it from slipping. An account of the difference in diameter of the two pairs of pans, the outer pair is rotated at a less angular velocity than the inner, so as to obtain a similar velocity for both pairs.

In operating this machine, the muddy liquid introduced through the pipe 18 is thrown against the inner wall of pan 5

and overflows over the shallow flange 19 into pan 6, where the same action is repeated, and again in pans 7 and 8, the liquid all the time becoming clearer and clearer, lastly reached the casing 10, from which it discharged through the gutter 27. Any scum arising is sucked out by the "skimmers," 28, 29, 30 and 31. After the machine has been running for some time, its velocity is decreased, and hot water and steam introduced through nozzles 32, 34, 35 and 36, the pans being thus cleaned out thoroughly, and the mud running down into the pit 33. This cleaning operation takes only a few minutes, after which the machine is started up again to re-commence its clarifying operation.

CANE MILL HAVING ROLLS WITH PRISMATIC OPENINGS RECEIVING PRISMATIC SHAFTS.

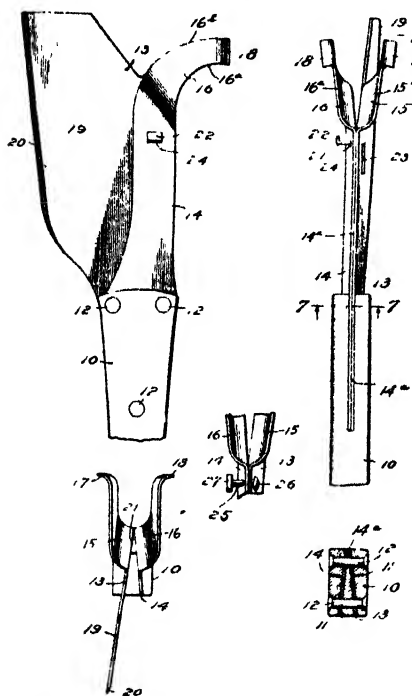
Frank B Rogers, of Belleville, St. Clair, Ill., U.S.A. (1,355,620).

March 17th, 1919; October 12th, 1920. (Three figures).

Keying the rolls to the shafts has proven unsatisfactory owing to the liability of the keys becoming broken; and rolls are sometimes either cast integral to the shafts or shrunk to the shafts. According to the statement of the inventor, these methods have proven not only expensive but have caused difficulty in renewing the rolls or shafts in case of breakdown. He overcomes these defects by providing hollow rolls with prismatic openings adapted to receive prismatic shafts, which are provided with suitable bearing blocks to form bearings in the frame of the machine. The type of mill depicted in the drawings accompanying this specification appears to be a vertical 3-roller. Claim 1 states: In a cane mill, the combination with a supporting frame, of a prismatic shaft supported in said frame, a hollow crushing roll provided with a prismatic opening to receive the shaft, and a pair of bearing blocks mounted in said frame and provided with prismatic opening to receive the shaft.

COMBINED CANE STRIPPER AND CANE KNIFE. *James W. Barwick, assignor to Mark A. Palmour, of Atlanta, Georgia, U.S.A. 1,357,137. December 29th, 1919; October 20th, 1920. (Eight figures.)*

An implement is provided which one may use to strip the leaves, top the cane, rake the leaves from the base of the stalk, and cut the stalk close to the ground. When applied as a stripper, it functions by being pulled downwardly, requiring less power to do its work than does the ordinary cane stripper, and it so embraces the stalks that the leaves are removed on all sides. Furthermore, it does not slash into the stalk. Referring to the figures, 10 is the handle of the implement, which handle is provided with the longitudinally extending kerfs 11, disposed at an angle to to each other as shown in the figure. Two blades 13 and 14 are set into these kerfs at an acute angle to each other, rivets 12 or the like being passed through the handle and blades to secure the same together. With the blades



13, 14 set in the kerfs, they will meet at one face of the handle, as indicated at 14^a. Both spring steel blades 13 and 14 have protruding tongues or end portions extending outwardly upon the upper ends of the same, said tongues or end portions being bent away from each other as indicated at 15 and 16, then brought to approaching relation, and finally flared outwardly to form lateral lips 17 and 18. These end portions or tongues are also curved in such a way that their outer ends lie approximately at right angles to the handle. The lower or working edges 15^a, 16^a of the protruding tongues are blunt so that when the implement is passed down along the stalk, as shown in the figure, the same will be cut open.

One of the blades, as 13, is provided with an integral enlarged longitudinal extension 19 forming a knife with a cutting edge 20. This knife is preferably of a length greater than the length of the remainder of the blade and has a width considerably greater than either blade. The knife is located directly opposite the point where the blades engage each other.

In order to prevent too great a separation of the blades, a stop means is provided which allows limited separation of the blades but prevents their being spread apart so far as to become permanently bent. One form of stop means, which comprises a tongue 21 struck out from one of the blades, as 13, leaving a slot or perforation 23 and being passed through a hole 24 in the opposite blade 14. The outer end of the tongue 21 is bent at right angles to form a head 22, which engages with the outer face of the blade 14, when the blades are spread apart a distance equal to the length of the tongue 21. Another form is shown in Figure where one of the blades 13 has riveted thereto a stud 25, as shown at 26, the other end of the stud having a head 27.

CONVEYING AND COOLING APPARATUS FOR CONFECTIONS AND THE LIKE. *Fred. W. Leyland and Edward P. Brock, of Boston, Mass, U.S.A. 1,364,121. January 4th, 1921.*

CANE HARVESTING AND WINDROWING MACHINE.¹ *Henry O. Scranton, of Jeanerette, La., U.S.A. 1,365,955. September 10th, 1919; January 18th, 1921.*

¹ See also *I.S.J.*, 1920, 593.

UNITED KINGDOM.

UTILIZATION OF MOLASSES FOR YEAST PRODUCTION. *Fleischmann Co.* (Assignees of *M. Nilsson and N. S. Harrison*), of New York, U.S.A. 148,378 (20,293). July 9th, 1920; convention date, January 7th, 1919; not yet accepted; abridged as open to inspection under Section 91 of the Act.

Fermentation is carried out in the presence of a phosphorus compound, as phosphoric acid, a phosphate, or an acid phosphate, the liquid being aerated, and kept in a neutral condition during the operation by the addition of ammonia or of an alkali hydrate or carbonate.

FRUIT SYRUPS, JELLIES, "MARMALADES," CONSERVES, ETC. *O. and C. Biemann*, of Magdeburg, Germany. 148,407 (20,352). July 9th, 1920; convention date, March 14th, 1919; not yet accepted; abridged as open to inspection under Section 91 of the Act.

In the manufacture of fruit juice or jelly with simultaneous production of "marmalade" or conserve by circulating sugar solution in counter-current through vessels containing fruit and like vegetable products, as described in the patent specification,¹ the extraction process and production of conserve are carried out in a single vessel, the temperature in which increases from above downwards.

MANUFACTURE OF ULTRAMARINE BLUE. *J. B. Giumet and A. Guillochin*. 152,916 (4576). February 14th, 1920.

Sulphites or bisulphites of the alkalis or mixtures of these salts are used in the manufacture of blue and green ultramarines to replace wholly or partially the alkali carbonates or sulphates usually employed. The sulphite of soda obtained as a by-product in the preparation of phenol is particularly suitable for this purpose. In an example, the furnace charge consists of kaolin, sulphite of soda, sulphur, and a reducing-agent such as resin.

MANUFACTURE OF MANURE CONTAINING PEAT. *Molassine Co., Ltd.*, of Greenwich, London; and *H. C. S. de Whalley*. 152,779 (18,234). July 22nd, 1919.

In a fertilizing compound, such as is described in a previous Specification,² comprising peat mixed with some substance which liberates ammonia to an amount sufficient to make the mass slightly alkaline, calcium cyanamide is employed as the product for generating ammonia. Calcium carbonate is added to prevent acidity while the ammonia is being generated, and phosphates and potash salts may also be added. Potassium or sodium chloride or sulphate, or mixtures thereof, may be added.

MANUFACTURE OF YEAST FROM THE FERMENTED MUST OF MOLASSES AND BEET PULP.

Lucien J. P. M. J. Dupire, of Ramecourt (Pas-de-Calais), France. 149,438 (12,020). May 13th, 1919; August 13th, 1920.

Before fermentation the musts are diluted to such a proportion that the yeast will find therein only the quantity of sugar necessary and sufficient to enable it to attain its full development. After fermentation the yeast is separated by centrifugal treatment.³

PRODUCTION OF ACETONE AND BUTYL ALCOHOL BY FERMENTATION. *Charles Weizmann*, of Kensington, London, W. 149,355 (2786). February 24th, 1916; August 19th, 1920.

Wort containing 4 to 9 per cent. of carbohydrates having an acidity not higher than 0.4 to 0.6 per cent. is inoculated with a culture of the bacillus *Granulobacter pectinovorum* (as prepared in the manner described in a previous specification⁴), and fermentation conducted at 34-36°C., the time necessary being about 36 to 48 hours. In an example given the wort is prepared by using 6 to 10 per cent. of malt, and sterilized previous to treating with the organism mentioned.

¹ U.K. Patent, 147,838; *I.S.J.*, 1921, 113.

² U.K. Patent, 14,887; *Cf.*, *I.S.J.*, 1917, 238.

³ See U.K. Patent, 123,711; *I.S.J.*, 1919, 529.

⁴ U.K. Patent, 4845 of 1915.

HEAT EXCHANGERS. *E. J. Richards*, of Croydon, Surrey. 152,734 (17,561). July 14th, 1919.

A seamed tube having a polygonal (e.g., hexagonal) cross-section and enlarged ends for use in the construction of honeycomb radiators and like heat-exchangers is described. It is formed with the seam running throughout the whole length instead of only between the enlarged ends. The lap of the seam extends over half the width of the inner surface of a flat side of the tube.

CENTRIFUGALS. *P. T. Sharples*, of St. David's, Pennsylvania, U.S.A. 153,041 (15,792). June 23rd, 1919.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

MACHINE FOR HARVESTING CANE. *P. T. Woodland*. 155,023 (22,190). September 9th, 1919.

MACHINE FOR BREAKING COCOA CAKE. *J. Baker & Sons and W. E. Prescott*. 155,320 (18,721). July 28th, 1919.

PRESSES FOR MAKING PASTILLES. *E. Gaillard*. 155,594 (35,722). June 11th, 1919.

PURIFICATION AND SEPARATION OR FILTRATION OF LIQUIDS. *J. N. A. Sauer*. 155,609 (15,601). June 20th, 1919.

STERILIZATION AND PURIFICATION OF WATER. *J. N. A. Sauer*. 155,610 (15,603). June 20th, 1919.

FILTERING, DECOLORIZING, AND PURIFYING LIQUIDS, JUICES, ETC. *J. N. A. Sauer*. 155,611 (15,606). June 20th, 1919.

DRYING VEGETABLES OR THE LIKE. *W. Spoelstra*. 155,625 (21,567). September 2nd, 1919.

MANUFACTURE OF SWEETMEATS, BISCUITS, ETC. *T. N. Reading*. 155,724 (4422). February 13th, 1920.

CONFECTIONERY MANUFACTURE. *Kelley-Clarke Co.* 124,449 (2030). March 26th, 1917.

CENTRIFUGALS. (1) *C. A. Fesca & Sohn*. 137,827 (978); 145,397 (979). June 18th, 1919. (2) *A. Melotte*. 156,070 (22,313). December 26th, 1919.

LIQUID LEVEL INDICATOR. *L. Badois*. 156,030 (8786). March 26th, 1920.

FILTER-PRESSES. (1) *H. Plauson and J. A. Vielle*. 155,834 (36,169). July 5th, 1918. (2) *W. Paterson*. 156,270 (3701). March 2nd, 1918.

MANUFACTURE OF PHOSPHATIC MANURES. *H. Plauson and J. A. Vielle*. 156,124 (36,465). November 5th, 1919.

CONSERVATION OF VEGETABLE MATERIALS. *T. Schweizer*. 156,173 (36,671). October 20th, 1919.

CUTTING CANE BY MECHANICAL POWER. *M. Wertheim*. 156,298 (22,081). September 8th, 1919.

MANUFACTURE OF A PRECIPITATE FROM RAW BEET JUICE. *M. von Wierusz-Kowalski*. 132,798 (22,774). July 11th, 1916.

ELECTRO-OSMOTIC SEPARATION OF SUBSTANCES. *Elektro-Osmose Akt.-Ges. (Graf Schwerin Ges.)* 144,710 (15,775). April 8th, 1918.

FILTERS. (1) *Braden Copper Co.* 156,583 (36,103). January 2nd, 1920. (2) *W. F. L. Beth*. 156,181; 156,182 (34, 35). January 3rd, 1920.

EVAPORATORS. *K. L. E. Thunholm*. 156,592 (523). March 4th, 1918.

SEDIMENTATION APPARATUS. *Dorr Co.* 133,716 (24,936). October 5th, 1918.

MOTOR FUEL. *E. W. Stevens*. 135,514 (29,010). November 21st, 1917.

Patents.

- CENTRIFUGALS.** (1) *De Laval Separator Co.* 142,860 (12,631). August 31st, 1917. (2) *P. T. Sharples.* 157,688 (16,857). June 22nd, 1920. (3) *E. G. N. Salenius.* 157,366-157,360 (1249-1262). December 6th, 1917. (4) *A. J. M. Rialland.* 157,974 (1746). April 30th, 1919.
- ALCOHOL MANUFACTURE.** *H. Dreyfus.* 157,048 (12,236). March 22nd, 1917.
- CANDY MANUFACTURE.** *Vacuum Candy Machinery Co* 156,702 (736). January 16th, 1914.
- DESTRUCTION OF MICRO-ORGANISMS IN LIQUIDS.** *Candy Filter Co., Ltd.* 157,280 (1190). January 8th, 1920.
- EVAPORATORS.** (1) *J. F. Ruff.* 157,514 (24,393). October 6th, 1919. (2) *Griscom-Russell Co.* 158,219-158,221 (23,877-24,291). January 26th, 1920.
- MACHINE FOR LIFTING BEETS.** *W. S. Graham.* 157,339 (1310). August 8th, 1917.
- DECOLORIZING MATERIALS.** *Catlin Shale Products Co.* 157,393 (1314). April 26th, 1916.
- MOULDING CONFECTIONERY.** *R. Letang and R. Rouart.* 157,775 (1483). December 2nd, 1913.
- CARAMEL MANUFACTURE.** *H. Luers.* 157,862 (1593). December 17th, 1919.
- SPECIFIC GRAVITY DETERMINATION.** (1) *H. G. Evans.* 158,018 (22,603). September 15th, 1919. (2) *S. D. Wells and R. J. Marx.* 158,151 (1929). January 21st, 1920.

The 1920-21 Cuban Cane Sugar Crop.

Messrs. Guma and Mejer's First Estimate.

Below are the figures of the production of sugar in Cuba during the present season, as calculated by Messrs. GUMA & MEJER, the well known Havana statisticians:—

	CENTRALS	SACKS.
Habana	26 ..	2,367,000
Matanzas	24 ..	3,285,000
Cárdenas	17 ..	2,670,000
Cienfuegos	23 ..	2,470,000
Sagua	16 ..	1,605,000
Caibarién	15 ..	1,945,000
Guantánamo	12 ..	897,000
Cuba	7 ..	855,000
Manzanillo	9 ..	770,000
Santa Cruz del Sur	1 ..	435,000
Nuevitás, Pastelillo, P. Tarafa	25 ..	4,400,000
Antilla	12 ..	1,245,000
Nipe Bay	1 ..	450,000
Jacaro, Palo Alto y B. Grande	5 ..	2,060,000
Puerto Padre y Vita	3 ..	1,400,000
Banes	1 ..	500,000
Manatí	1 ..	450,000
Zaza	2 ..	48,000
Trinidad	1 ..	100,000
Total.. . . .	201	27,952,000

Equal to 3,993,142 long tons.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING FEBRUARY 28TH.		TWO MONTHS ENDING FEBRUARY 28TH.	
	1920. Tons.	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS.				
Germany .....	....	....	....	....
Netherlands .....	....	....	....	....
Belgium .....	....	....	....	....
France .....	....	....	....	....
Czecho-Slovakia .....	....	....	....	....
Java .....	....	5	375	16,492
Philippine Islands .....	....	....	....	....
Cuba	49,803	....	76,914	....
Dutch Guiana .....	....	....	....	72
Hayti and San Domingo ..	....	....	....	....
Mexico .....	....	....	....	....
Peru	2,415	14,078	12,816	22,736
Brazil	2,578	11,828	3,911	20,916
Mauritius	41,355	26,134	53,153	47,683
British India	148	....	1,142	....
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	5,529	7,868	9,704	19,885
Other Countries	2,903	3,106	3,777	12,074
Total Raw Sugars.....	104,781	63,020	161,797	139,858
REFINED SUGARS.				
Germany .....	....	600	125	601
Netherlands	10	445	970	445
Belgium	211	77	289	97
France	1	....	1	1
Czecho-Slovakia .....	....	....	19	....
Java	7	....	5,007	3
United States of America ..	11,206	149	43,751	156
Argentine Republic .....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	4,510	1,848	7,227	1,992
Total Refined Sugars ..	15,945	3,120	57,391	3,295
Molasses	6,628	2,413	13,555	6,282
Total Imports.....	127,304	68,553	232,743	149,485

EXPORTS.

	Tons.	Tons.	Tons	Tons
BRITISH REFINED SUGARS.				
Denmark .....	....	....	....	....
Netherlands	1	269	2	358
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	26	110	51	224
Canada .....	....	....	....	....
Other Countries	1	315	5	477
FOREIGN & COLONIAL SUGARS.	28	693	58	1,060
Refined and Candy	101	6	331	11
Unrefined	5	15	1,228	495
Various Mixed in Bond .....	....	....	....	....
Molasses	90	90	478	142
Total Exports.....	224	804	2,096	1,708

Weights calculated to the nearest ton.

United States.

(Willet & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920 Tons.
Total Receipts January 1st to February 24th ..		254,212 ..	463,995
Deliveries		256,118 ..	463,995
Meltings by Refiners		234,946 ..	361,741
Exports of Refined		7,000 ..	50,000
Importers' Stocks, February 23rd		9,146 ..	—
Total Stocks, February 23rd		76,927 ..	69,427
		1920.	1919.
Total Consumption for twelve months		4,084,672 ..	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1917-1918, 1918-1919, AND 1919-1920.

	(Tons of 2,240 lbs.)	1917-18 Tons.	1918-19 Tons.	1919-20. Tons.
Exports		3,176 ..	76,611 ..	—
Stocks		64,362 ..	71,625 ..	17,720
		67,538	148,236	17,720
Local Consumption		1,200 ..	500 ..	500
Receipts at Ports to December 31st		68,738	148,736	18,220

Havana, December 31st, 1920

J. GUMA.—L. MEYER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWO MONTHS ENDING FEBRUARY 28TH, 1913, 1920, AND 1921.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	126,736 ..	57,391 ..	3,295	219 ..	331 ..	11
Raw	130,367 ..	161,797 ..	139,858	544 ..	1,228 ..	495
Molasses	7,859 ..	13,555 ..	6,282	71 ..	478 ..	142
	264,962	232,743	149,435	834	2,037	648
HOME CONSUMPTION.						
	1913. Tons.	1920. Tons.	1921. Tons.			
Refined	122,755 ..	51,631 ..	3,514			
Refined (in Bond) in the United Kingdom	113,892 ..	103,532 ..	163,140			
Raw	17,099 ..	60,429 ..	20,474			
Molasses	5,137 ..	8,342 ..	1,906			
Molasses, manufactured (in Bond) in United Kingdom ..	6,661 ..	12,355 ..	7,155			
Total	265,544	236,289	196,189			
Less Exports of British Refined	4,193	58	1,060			
	261,351	236,231	195,129			

Sugar Market Report.

Our last report was dated 7th February, 1921.

It was announced by the Food Controller on the 21st February, that an agreement had been made with the British Sugar Refiners for the disposal of the balance of Government stocks of raw sugar, and that from 28th February all restrictions on the importation of sugar would be withdrawn. At the same time the official price for Granulated, Crushed and White pieces was reduced from 72s. to 67s. 6d. duty paid, spot terms, until 28th February. The terms of the agreement with the British refiners have not been made public, but it is understood that the balance of Government supplies of raws, estimated to be sufficient for requirements until about the end of August, will be drawn upon at prices subject to frequent revision.

A considerable amount of activity followed the announcement of the date of decontrol, trade orders coming in freely; not only for home refined, but for anything in the nature of foreign refined which was available for immediate shipment. Good quantities of Czecho-Slovakian superior Granulated have been sold at 37s. to 37s. 4½d. f.o.b. Hamburg, Dutch at 37s. to 38s., Polish 36s. to 36s. 6d., Belgian Crystals 36s. 6d. to 37s. f.o.b., and American Granulated c.i.f. U. K. ports at 37s. to 37s. 6d. There is no inclination to enter into forward purchases at the moment. W. I. Crystallized descriptions on the spot are in small supply, and value 60s. to 61s. 6d. duty paid. Muscovados, best quality, 52s., medium 45s., and low 32s. to 38s.

There are now 186 centrals grinding in Cuba, and weekly receipts are approximating more closely to those of last year, although the total receipts to 26th February still show a deficit of more than 400,000 tons. Some advices from the Island speak of a total of less than 3,000,000 tons, and opinions are freely expressed on this side that 3,500,000 tons will not be reached. The formation of a Committee in Cuba to control the sale of the balance of the 1920-21 crop, working in conjunction with prominent firms in New York, may be regarded as an important feature likely to assist materially towards the reconstruction of finance in the Island, and if the declared policy of selling freely at prevailing prices and not withholding or hoarding sugar, be adhered to, it should prove beneficial alike to both producer and consumer. Already some 60,000 tons have been marketed for February-March shipment at 4 75 cents c.&f., equal to 4 60 cents f.o.b., which compares with the low-water mark of 3 30 cents f.o.b. quoted in our report last month. Under the Emergency Tariff Bill, which is being considered at Washington, it is proposed to fix the Tariff Duty on 90° centrifugal at 2 cents per lb. for sugars other than Cuban, with a rate of 1 6 cents per lb. for Cubans. The Bill was expected to come up for decision towards the end of February.

Java quotations show some improvement for old crop, Whites being quoted at 27 guilders (40s. 6d. per cwt.) f.o.b. At the moment the demand for India is very quiet, owing to the fall in the exchange. There are sellers for March-April shipment at 40s. 6d. c. & f. Calcutta basis, and no buyers. It is estimated that over 500,000 tons New Crop have been sold by the mills, and up to 21½ guilders (32s. 3d. per cwt.) has been paid for early shipments, but only a limited proportion of this quantity has been disposed of for actual shipment away from the Island, and the maintenance of, or improvement in, New Crop values remains to be tested largely by the capacity and ability of Eastern countries to take the sugar. A feature common to almost every consuming country in the world at present is the bareness of invisible supplies, which makes it impossible to gauge the extent to which apparent consumption could be increased, given favourable circumstances, such as might be engendered by improving finances, increase of employment, and growth of confidence generally.

Shipments from Java during January which totalled 85,750 tons, comprised 3650 tons to Port Said for orders, 17,700 tons U. K. and Continental ports, 14,250 tons India, 6200 tons Japan, 8450 tons Australia, and 35,500 tons Singapore and other Eastern destinations.

Czecho-Slovakia is reported to have sold 45,000 tons to France, and it is probable that this quantity was included in the 74,000 tons officially announced as having been sold abroad at favourable rates. 9000 tons have been exchanged for cereals and flour, and a further 25,000 tons have been reserved for similar treatment.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
7th March, 1921.

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✉ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Production and Consumption.

Elsewhere in this issue, we publish a couple of articles from the pen of our Continental correspondent, dealing with important aspects of the outlook for sugar consumption in the world. First of all, he points out that in the last years prior to the war there was a tendency on the part of several European Governments to reduce their internal duties on sugar in the hope that the revenue would be maintained at the same level by means of a lower duty producing an increased consumption; but since the armistice the tendency of the Governments concerned has been all the other way, the sugar duties having been variously increased, obviously with a view to the urgent need for revenue. Our correspondent, however, opines that the only result will be to decrease the consumption, because sugar is an article of semi-luxury—it is needed to a large extent as an article of food, but above that it serves as an ingredient of a number of cheap non-necessities when it is itself cheap enough; when sugar is dear only that percentage (if as much) that can be classified as food is bought, the other uses being largely dropped by the consumer for the time being.

Secondly, our correspondent points out that actually the time has arrived when the "luxury" use of sugar has begun to be seriously curtailed, because the inflated earnings of the consumer, to which the war gave rise, are being everywhere gradually eliminated, partly through actual wage reductions and partly through unemployment which is getting everywhere rife and amounts to a wage cessation. Consequently, it is no longer possible for the maker of sugar to assume that he has only to look after the production and that consumption will exist to take over the stocks he turns out. Henceforward the producer will have to take into consideration the probable consumption of the world when debating what amount of sugar to produce; otherwise there will be an excess which would only depress the market.

Our correspondent gives figures to show that the average consumption of the world for the first ten years of this century was round about 14 million tons, and consequently if this year the figures of 1910-11 (17 million tons) are attained, it will in his opinion cover the present day demand, having regard to the probable

purchasing capacity of the more or less impoverished consumer at large. Assuming this to be the case, there would then be little justification for developing the production of world's sugar much beyond the current output if prices are to be maintained at a remunerative level.

But our own view is that while it is possible to curtail production at short notice by limiting sowings and plantings, it is not so easy a matter to increase production at the same short notice if the increase involves more output than the factories are at present designed for. Preparations to increase production by enlarging plant or building new factories take in many instances more than one or two seasons to fructify; hence in deciding at the present moment what should be done in the matter of increasing production or the reverse, it is necessary to look well ahead and not merely judge by the present day economic situation. Rather must one ask what is likely to be the demand two or three years hence when the world has had that time further to recover from the effects of the war and get down to the bed level of steady production at an economic cost. It is never safe to prophesy, but present indications do not warrant the supposition that the world is going to extend the experiment of Bolshevism beyond the confines of Russia where it is proving a failure, and if extremist factions can be successfully resisted, there is no reason why commonsense should not bring about a compromise between the conflicting issues that divide Capital and Labour, and lead eventually to a workable arrangement which shall allow steady employment and consequently a steady output of spending. Such an achievement would result, *inter alia*, in increasing the consumption of sugar everywhere, so the only question is: What is the probable total that the world is likely to consume per annum two or three or more years hence if all goes well with the tranquillizing efforts of Governments and leaders of men?

We expressed the opinion a few months ago that if sugar were as cheap as in pre-war days and other things were fairly equal, the present consumption in the world might be assumed at as much as 25 million tons per annum. This is probably still an outside figure, for sugar is no longer so cheap in view of the increased cost of production, especially of labour. But as wages will probably never be so low, either, in other walks of life, it is probable that eventually the coming "cheap" price of sugar will be cheap enough for the new prevailing wage standard. One has only to consider the economic situation in the United States as existing for years past to see that a high cost of living may yet be accompanied by an ample means to spend, in order to premise that the new levels of wages and living in the future will leave the quantitative purchasing power of the individual much as it was before. There seems therefore no reason why in the long run there should not be a steadily increased demand for sugar in the world, all the more as the present day consumption of the larger proportion of the world's population is still infinitesimal. There is, for example, endless scope for an increase amongst the coloured races of Asia, and as these races get more and more leavened with some of the advantages and usages of Western civilization, an increase in their consumption of sugar is one of the least remote possibilities.

All things considered, then, we venture to suggest that while the present day is one for exercising some caution amongst sugar producers lest an excess of sugar prematurely produced demoralizes the world's sugar market, the wider future is one that offers considerable scope for hopefulness on the part of sugar men, since sugar is not a passing fancy so much as an established food, and once the taste for it is acquired its consumption is a matter of course, always providing the purchasing power of the public is commensurate with its average cost.

The Cuban Sugar Finance Commission.

There was a time when the Cuban producer of sugar for lack of funds and storage capacity was more or less at the mercy of the New York market in respect of the price he got for his sugar; latterly however the situation has greatly improved for him and down to the time of the financial crash in Cuba last summer he was able to more than hold his own. But the last few months the want of funds—that is of credit from the banks—which is the outcome of the moratorium resulted in the Cuban producer again having to sell immediately and so put him once more at the mercy of prospective purchasers. As our American correspondent points out in his able summary of the situation given on another page, in February the price of Cuban 96° centrifugals had declined to 3½ cents c. and f., New York while it had cost the Cuban producer probably 5 cents. Such a position would have been unenviable if prolonged, so the Cuban Government came to the rescue and appointed a Finance Commission to take over the task of selling Cuban sugar for export. As shown elsewhere, this plan though it met with some opposition partly engendered by doubts as to its success, secured the support of 80 per cent. of the interested parties in Cuba,¹ and on coming into operation the Commission speedily justified its existence and has eased the situation considerably, while prices have risen appreciably since it was first mooted.

We may add that the seven members of the Commission consist of MANUEL RIONDA, chairman of the board of directors of the Cuba Cane Sugar Corporation, and R. B. HAWLEY, president of the Cuban American Sugar Company, representing the large producing companies; J. M. TARIFA and MANUEL ASPURU, representing the smaller producers, or so-called independent companies; PORFIRIO FRANCA of the National City Bank; FRANK J. BEATTY of the Royal Bank of Canada, and General EUGENIO AGRAMONTE, Secretary of Agriculture, Commerce and Labour of Cuba, representing the Cuban Government.¹

Cuban Trade with England.

It is unfortunate that the friendly trade relations hitherto existing between the United Kingdom and Cuba have lately been somewhat clouded by the effects that are alleged to have resulted from the imposition in this country in last year's Budget of an *ad valorem* duty of 50 per cent. on foreign cigars imported into the United Kingdom. The Cuban cigar manufacturers are up in arms against the new duty which they affirm is damaging their trade with this country to a pronounced extent, and there has been talk of retaliation which has culminated in the introduction in the Cuban Congress of a Bill by a private member to impose by way of reprisal an additional 40 per cent. on British goods entering Cuba. It is true that the bill stands little chance of being discussed just now, as the Cuban Congress has not been transacting business for some while; but that it should have been introduced shows some measure of the resentment that has been felt in Cuban cigar circles.

We are not concerned with the rights and wrongs of the cigar trade, but it would be unfortunate for British trade in sugar one way and sugar machinery the other way if the Cuban Government were forced to give countenance to measures of reprisals. The United Kingdom has been a big purchaser of Cuban sugar in the past, and British machinery, if it has been eclipsed of late years in Cuba by the more easily secured American plant, has still a reputation in the island second to none. It is to be hoped that the cigar difficulty may be cleared and it is quite

¹We are indebted to *Facts about Sugar* for this descriptive list.

possible that when the 1921 Budget is published it may revise the duties at present handicapping the import of cigars into this country, all the more as the British consumer of Havana cigars is inclined on his part to protest at the prohibitive price he is charged for them as the result of the high duty.

The Essentials of Sugar Cane Production.

In a recent number of the *Philippine Agricultural Review*, Mr. C. W. HINES, Sugar Technologist, writes a thoughtful article on "Essentials in the Production of Sugar Cane," which might, with advantage, be studied by cane planters in all parts of the world. It contains a résumé of the chemical and manurial aspect of field work from start to finish. It is written in popular language and covers the whole ground of soil formation and treatment for maximum crops, and explains current manurial practice as developed during the past quarter of a century. Mr. HINES, it seems to us rightly, contends that, with proper safeguards, sugar cane is not nearly so exhaustive a crop as is usually supposed. While it may be true that an enormous mass of vegetation may be reaped each year in a cane field—a good crop should contain from 40,000 to 50,000 canes for each acre of land, each weighing at least two pounds and each surmounted with a 5 ft. bunch of leaves—it is pointed out that the actual sugar recovered, being made up entirely of carbon and water, is none of it actually obtained from the soil, but is provided by the air and soil water. Thus, with a close attention to the return of all the unused parts, whether cane trash, bagasse ashes, waste molasses, or filter press cake, all of them in a condition specially suited to the feeding of the plants, comparatively little should be needed in the way of added artificial manures. There should be no such thing as "worn out" soils, as is shown by the example of China, where, after thousands of years of continuous cultivation, the land in many parts is producing considerably larger crops than ever before. And if, he asks, with the rudimentary knowledge of agricultural principles obtaining in that country, such results can be secured, what might we not expect from the up-to-date planter, with the full resources of modern agricultural science at his disposal?

Commencing with a study of soil formation, the author deals in turn with its physical condition and texture, the mineral and organic constituents; and the elements actually isolated by the growing cane plants, potassium, phosphorus, nitrogen and calcium, are reviewed in special sections. In each the occurrence in nature is described, the special use in the plant's economy, the way in which the natural deposits may be rendered available and the most useful form in which they are given as manures. As is natural, the organic matter in cane soils receives marked attention, for on its abundance depends the action of the beneficent bacteria by whose activity the free nitrogen of the air is fixed in the soil so as to be available for the canes. Great emphasis is laid by the author on toxins in the soil, that is substances supposed to be given off by the roots which are harmful to the canes, and an example is given of otherwise fertile land in the Philippines, under "tigbaw" (*Saccharum spontaneum*) which cannot be used for sugar cane until a good deal of preliminary work has been done to get rid of its effects in such land. The article is illustrated by a couple of interesting diagrams, well known in textbooks of agriculture. The first is especially useful for guarding against the wrong application of artificial manures, in that it distinguishes at a glance those that may be mixed and applied irrespective of one another, those that must be applied immediately after mixing, and those that must never be applied to the fields at the same time. The second diagram illustrates the complicated cycle of nitrogen in agriculture, how it is obtained from the air and imprisoned in the soil,

Notes and Comments.

how it is then gradually worked up by bacteria into the form of nitrates which the plants require, and the way in which, by improper cultivation, the beneficent action of the nitrate formers is thwarted and the valuable stores of manure thus rendered available are lost and returned to the air. As we regard this article as of considerable educative value, we give in another part of this number of the journal a selection of the points made by the author.

Indigenous Stock Feed versus Imported Grain and Hay.

The advisability of improving the fodder supplies of cattle on sugar estates has been referred to on several occasions in this Journal.¹ Last year we published some articles on the possibility of introducing some of the semi-wild and cultivated millets into the grass lands and waste places, as these require the minimum of water, cultivation and food material. Since we have learnt that these articles have met with much approval in certain quarters we return to the subject in the present issue, from a much wider point of view. The value of cattle manure on sugar estates is becoming increasingly recognized in many new countries where it was supposed at first that sugar cane could be raised on artificials alone, but with the introduction of motor-driven machinery cattle manure is becoming more and more difficult to procure in sufficient quantity. It is all the more necessary therefore to ensure that what is obtained is of as good quality as possible; this can only be attained by improving the cattle feed. The Report of the Committee appointed by the Hawaiian Planters' Association to investigate the question of stock feed in the sugar estates of those islands is a valuable document and takes the broadest view of the whole question. Owing to the dislocation of trade conditions caused by the war, the greatly increased cost of materials and labour and the uncertainty of prompt delivery of imported feed stuffs, the Committee has thoroughly overhauled the indigenous feeds which can be obtained in the islands themselves. All substances are passed in review, from the weeds on the estates, through the waste products of the factory and the cane tops, to various grasses, grains, legumes and roots which can be easily grown and fed, either fresh or dried to hay or shredded to "meal," and which may replace the costly imported grains of pre-war times. An interesting example is given in detail of a mixture of local materials fed as a daily ration to animals doing nine hours of heavy work, and the effect of this food is compared with the standard grain and hay ration during a six months' period. The imported ration consisted of 20 lbs. of Californian hay + 18 lbs. of grain (half oats and half barley). At the end of the six months the animals fed with the imported material were run-down and all of them had lost weight; those fed on local food, on the other hand, were quite up to their work and had every one increased in weight, some to the extent of 40 lbs.

While it is not suggested that it would be wise slavishly to follow the growing of the particular food plants enumerated in all countries, the lists are sufficiently comprehensive for deductions to be readily drawn as to what could be done, with a little experiment and trouble, largely to replace imported grain rations in most sugar lands which are not self sufficient in this respect, and we have given such details of the report on another page as seem to be necessary for those who wish to make the experiment on a comprehensive scale. The subject of costings cannot be left out in the plantation any more than in the factory, and, even if no great financial benefit may immediately accrue, it is of great importance that each sugar growing country should thoroughly investigate the possibilities of being self-

¹ *J.S.J.*, 1920, pp. 493, 613, 684.

supporting, in view of the present uncertainty in world conditions. We would therefore seriously commend the findings of this Hawaiian Stock Feed Committee to all who have the best interests of the sugar industry at heart.

Mauritius and British Rule.

A short while ago a small section of the Mauritius community petitioned the French President to bring pressure to bear on the British Government to return Mauritius to the custody of the Republic. The local controversy engendered by this resulted in the recent elections in the island virtually turning on the question as to which power should own the island. It is interesting therefore to note, on the authority of the *South African Sugar Journal*, that the first election that has taken place (owing to the war) for ten years past has resulted in the ten contested seats being captured by Britishers. This, as our contemporary remarks, should put an end to any further talk on the matter. Mauritius has always had a considerable French element in its population and the French language figures in the life of the island to an appreciable extent; but it would appear that the bulk of the population, whether of British or of French descent, are fully satisfied with their position as members of a British Crown colony.

The 1921 English Beet Campaign.

The new Kelham beet sugar factory which is to start operations next Autumn, is to have a total capacity of 60,000 tons of beet or 600 tons per day, but acting on the advice of the French experts who are supervising the inauguration of the scheme, only 20,000 tons will be dealt with this year derived from some 2365 outside acres plus 200 acres on the Kelham estate. The growers consist of some 425 farmers with an acreage each of $5\frac{1}{2}$ acres. The price is to be £4 per ton delivered at the factory which is equivalent to 67s. 6d. delivered on rail. According to the figures of the last test crop grown at Kelham, the cost per acre was £29 3s. 4d., the yield being 12 tons with an average sugar content of over 20 per cent.; hence with the roots selling at 67s. 6d. (£40 10s. for 12 tons) a fair profit should be shown if the Kelham test figures can at all be approximated by the growers.

As regards Cantley, the present position is that the minimum of 5000 acres needed to ensure a campaign has been more than promised by local farmers, hence it may be assumed that the factory will operate this year with a fair measure of success.

The Indian Sugar Crop: Final Official Forecast.

The final general memorandum of the Indian sugar cane crop of 1920-21, issued by the Department of Statistics at Calcutta, gives the estimate of the area sown this season as 2,553,000 acres, as against 2,686,000 acres last year, or a decrease of 5 per cent. The yield of gur is estimated at 2,465,000 tons, as against 3,036,000 tons, or a decrease of 19 per cent. This gives an average yield per acre of 2163 lbs. or rather less than a ton per acre. The season on the whole has not been favourable for the crops owing to deficient rainfall in some of the more important sugar producing provinces.

According to the *South African Sugar Journal*, Sir HENRY LECLEZIO, the "grand old man of the island" of Mauritius, who has been Chairman of the Legislative Council of the island for the past 25 years, has retired from his position and from his representation of Moka, feeling in need of a long rest. He is due to make a long sojourn in Europe and will probably take the opportunity to give the Colonial Office the benefit of his views on Mauritius affairs.

Fifty Years Ago.

From the "Sugar Cane," April, 1871.

EUGENE FELTZ was one of the earliest investigators taking up the question of the cause of the formation of molasses; and in this issue of the *Sugar Cane* he exposed some of his views. He held that the effect of the inorganic and organic salts present was physical rather than chemical, in that they increased the viscosity of the liquor to such an extent as gradually to inhibit the movement of the sugar molecule in the operation of crystal formation. In his own words, "the substances mineral or organic, crystallizable or uncrystallizable, which are generally met with in our molasses, do not possess any special power of dissolving sugar, as for a long time has been believed. They act in a purely physical, we might almost say mechanical, manner. Thus they may appear completely inoffensive in a solution rich in sugar, but their pernicious effect becomes more and more apparent in proportion as the solutions are poorer in sugar and fuller of impurities." He cited experiments in this paper showing that both calcium chloride and sodium carbonate, though classed by MARSHALL as negative molasses formers, "possess no power of dissolving sugar," but exhibit a marked effect in increasing the viscosity of concentrated solutions.

PATRICK NEILSON, of Trelawney, Jamaica, contributed a paper on the manufacture of rum, this being intended to be complementary to the article that had appeared in the previous issue by "J. S." He pointed out that the best results were obtained by slow fermentation conducted at a low temperature, and he remarks that "what in fact first drew my attention to seeking out a flavour in rum was the running I first got from what is known here as the 'dirty cistern,' a receptacle for all the refuse, bottoms, etc., of the other vats; I was astonished to find at the can pit mouth as the rum came over, an exquisite flavour . . ." He endeavoured to apply the conditions obtaining in the "dirty cistern" to distillery practice; and stated that he succeeded in getting such successful results that a rich fruity odour pervaded the house, which effect he thought was produced "not only by a slow decay or putrefaction going on, but also by an acid generated thereby." Other factors likely to contribute to flavour were considered to be the use of the skimmings having a very acid reaction; a moderate temperature; and the quality of the water used. He also believed that the use of "rum cane" constituted one of the details requisite for producing good flavour, that is rotten or half eaten cane, which had been allowed to undergo a slow fermentation while lying in the field and yard.

It was announced in this issue that at a sitting of the Chamber of Agriculture, Mauritius, a letter was read by M. LEMERLE, of Réunion, stating that he had been so fortunate on his estate at Rivière-des-Creoles as to establish the possibility of the reproduction of sugar cane from seed. The President closed the long discussion which followed the reading of this letter by saying that the future would show the extent of the importance of the discovery.

A patent taken out by J. F. CAIL² was abstracted in this issue. Cane was supplied by a travelling table to three 2-roller mills, and macerated with water while passing from the first to the second, and from the second to the third.

¹ I.S.J., 1921, 127.

² English Patent, 2212 of 1870.

The International Saccharimetric Normal Weight Question.

It is now possible to state the result of the enquiry made among British chemists in regard to the proposal urged by Dr. C. A. BROWNE and other American chemists¹ to adopt an international normal weight of 20 grms. for use with the quartz compensating polarimeter for sugar work.

In order to elicit opinion in the matter, a Committee was formed² consisting of the following:—Prof. A. R. LING, F.I.C., F.C.S. (who acted as Chairman); Prof. THOS. GRAY, D.Sc., Ph.D., F.I.C.; Mr. L. J. DE WHALLEY, B.Sc., F.I.C.; Mr. HUGH MAIN, B.Sc., F.C.S.; and Mr. J. P. OGILVIE, A.I.C., F.C.S. Mr. W. H. GIFFARD, and latterly Mr. OGILVIE, acted as Secretary. This Committee drew up a statement of the arguments *pro et contra*, nearly 2000 copies of which were sent to chemists engaged in the sugar and allied industries, both in this country and in the British Colonies. A summary of the replies received to the five questions asked is as follows:—

1. *Which form of saccharimeter and what normal weight do you employ?*—About 96 per cent. of the chemists replying stated the form of saccharimeter used by them to be a half-shadow quartz compensating instrument. Further details were not given. In regard to the weight employed, about 70 per cent. gave this as 26 grms. in 100 metric c.c., the remainder still using 26·048 grms. in 100 Mohr c.c.

2. *Do you advocate the retention of the present solution containing 26 grms. of saccharose in 100 metric c.c. at 20° C.?* *If so, kindly state your reasons.*—Of those replying 72 per cent. expressed themselves to be in favour of the retention of the present standard of 26 grms. in 100 metric c.c. Replies were received from all the leading refiners in the United Kingdom, and these were unanimous in their opinion regarding the retention of the present standard. In regard to the reasons for this decision, most of the replies stated in substance that the advantages claimed for the proposed new standard were too slight to compensate for the considerable inconvenience, expense, and confusion that would (it was considered) be involved by its adoption. A very frequent additional reason was that owing to the smaller amount of sample taken for the assay, the accuracy of observation would be diminished. In an addendum to his reply, Mr. A. F. BLAKE, Chief Chemist, Atlantic Sugar Refineries, Ltd., St. John, Canada, said that he thought the 26 gm. value should be retained regardless of whether Herzfeld's or Bates' conversion factor is correct, or whether future investigations provide still another, "new instruments being made according to the best factor available at the time, and old ones being controlled and corrected by quartz plates standardized according to the latest factor."

3. *Or are you in favour of the proposal to employ a 20 gm. normal weight as a new international standard?* *Kindly state the reasons for your decision.*—The 28 per cent. in favour of the new standard mostly reiterated the reasons stated by Dr. C. A. BROWNE in support of the change. No fresh views were stated.

4. *Or do you favour the adoption of the French normal weight of 16·29 grms.?* In no case was the adoption of the French normal weight advocated.

5. *Have you any other views on the subject?*—A correspondent replying to this question said that while he advocated the retention of the 26 grms. standard for the present, if any change were made later 25 grms. would seem to be a more

¹ See also *J.S.J.*, 1919, 85, 106, 128, 408, 463, 520, and 621.

² *J.S.J.*, 1920, 384.

The International Saccharimetric Normal Weight Question.

suitable weight than 20 grms., since the accuracy of observation would not be appreciably diminished by the slightly smaller weight of sample taken, while the advantage claimed by Dr. BROWNE for the 20 grms. weight, in regard to easy conversion of readings into percentage values, would also be realized. Mr. S. HOARE COLLINS, of the Agricultural College, Armstrong College, University of Durham, in advocating the 20 grms. standard, suggested modifying the length of the observation tube "to save altering the graduation of instruments."

The Cuban Sugar Finance Commission.

(From our American Correspondent)

The most important development in the sugar situation during the past month has easily been the appointment by President MENOCAL, of Cuba, of the body designated as the Sugar Finance Commission with exclusive authority to sell Cuban sugar for export.

The appointment of the Commission was brought about as a result of the financial disturbance in the island and the consequent demoralization of its most important industry. The establishment of a moratorium several months ago and its renewal from time to time until February, when bills were enacted providing for the gradual liquidation of accounts, made it impossible for sugar producers to obtain the credit facilities on which they had been accustomed to rely for the making and harvesting of their crops. In cases where mills were put in operation and harvesting was begun, the necessity of realizing immediately upon the sugar produced put the holders of such sugar at the mercy of prospective purchasers. By the beginning of February the price of 96° test centrifugals had declined to 3½ cents a lb., cost and freight, New York. To produce this sugar had cost the Cuban probably five cents (2½d.) a lb. or more. Consequently there was no incentive for either the hacendado or colono to push production.

During the early stages of the grinding campaign the listlessness and lack of activity on the part of labourers and cane growers was so marked, and the interruptions to grinding through lack of cane so numerous, that it became evident that unless some means of improving conditions could be found probably not more than 50 per cent. of the estimated production for the season would be realized and that the sale at ruinously low prices of such sugar as was produced would plunge the island into a situation even more serious than had prevailed up to that time.

After taking counsel with men prominent in the sugar industry, President MENOCAL issued a decree appointing a Commission of seven members to take charge of the marketing of the unsold portion of the crop, subject to ratification of the plan by the producers of 75 per cent. of the 1919-20 output. It was carefully pointed out that the purpose in view was not the forcing of an unreasonably high price through the withholding of sugar from the market, but was to assure the orderly marketing of the crop, to prevent the sacrifice of necessitous consumers, to aid in the financing of the harvest, and to protect the interests of producers and consumers alike.

The proposal was severely criticised in various quarters and some members of the trade who were favourable to the underlying purpose of the plan were doubtful of its success. It was quickly ratified, however, by a large majority of the Cuban producers. Interests representing over 21,000,000 bags, or over 80 per cent. of

the previous year's outturn, ratified the proposal, and it was put into effect on February 22nd. Meanwhile it had been submitted to the Government of the United States and had been approved, with the stipulation that no attempt should be made to force prices above a level which would permit producers to realize a reasonable margin of profit.

The price of raw sugar began to improve even before the Commission plan went into effect, and this improvement has continued until now. Cuban centrifugals at present command a price of 5.25 cents a lb., cost and freight, equivalent to 6.27 cents duty landed. The Commission thus far has conducted its operations with a conservatism that has commended itself to the members of the trade. It has had sugars regularly on offer and has advanced its prices very gradually. Many of those who were at first incredulous as to the feasibility of the proposed plan now admit that it has a good chance of success, while on all sides it is agreed that it has had the effect of bringing about an improvement in prices sufficient to measure the difference between heavy, possibly ruinous, losses and a small margin of profit.

The decree from which the Commission derives its authority provides that it shall have sole authority to sell sugar for shipment outside of Cuba, and that the proceeds of all sales shall be distributed *pro rata* among the whole body of producers. A small commission is deducted to cover marketing expenses, and a percentage of the receipts is held back by the Commission to equalize changes that may be made in prices from time to time. In case individual producers make sales for export account without the authority of the Commission the shipment of such sugar is prevented by refusal to issue the shipping documents necessary to permit its departure from the island.

Thus far the Commission has functioned very smoothly and successfully. The allotments it has offered have been absorbed promptly; and as evidence that the experiment is considered a success by the Cuban Government and the producers of sugar, its authority has been extended to cover the unsold portion of last year's output as well as the current crop.

One effect of the advance in prices which took place coincident with the creation of the Commission has been a decided improvement in consumer demand throughout the United States. For months the distributing trade had been placing orders with refiners to cover merely its day to day requirements, and consumers had been restricting their buying in similar fashion. Within the past few weeks, however, the orders placed with refiners have increased in number and volume to such an extent that practically all the refining companies are several weeks oversold. Inability of the refiners to ship promptly has operated to strengthen the demand for Louisiana grades and for beet sugar. The latter has been selling of late in the Central States at a quarter of a cent a lb. above the wholesale basis of cane granulated instead of ten points lower as is ordinarily the case. All the refiners who are now in the market are quoting eight cents (4d.) a lb. for fine granulated. An advance of another quarter cent is believed to be imminent however.

New York, March 17th, 1921.

In reference to the article by Mr. W. MONTGOMERY in our January issue on the determination of lime salts in juices,¹ we are asked by the author to say that the table reproduced in that article were compiled by the Great Western Sugar Company, Denver Col., U.S.A.

¹ I S J., 1921, 39-42.

Essentials in the Production of Sugar Cane.¹

The knowledge of the evolution and complete history of the various soils in a plantation should be of much use to the up-to-date sugar cane planter. Under man's influence soils are being much more rapidly made and changed than by nature's slower methods, and it is of very great importance that this work should be carefully and properly done. The soil consists of rock particles, plant and animal tissues, various gases and water, and the main difference between soil and sub-soil is due to the action of these latter elements in disintegrating the rock particles and rendering their locked up stores of plant food available for the growing plant. Three classes of soil may be distinguished, according to treatment, namely, virgin soil where under long periods natural forces have been at work and have accumulated masses of food material in a readily available form, long continued cultivated lands which are still fertile, as in some parts of China where, after thousands of years of cultivation, the crops are heavier than ever before, and so called "worn out lands," where by improper methods the stores of food have been dissipated and remunerative crops can no longer be obtained. Fallowing, formerly greatly used in such cases, is in modern intensive agriculture no longer necessary, for even when the conditions are favourable for the work of ameliorating bacteria, the results obtained by it are slow and uncertain; rotation of crops has taken its place, with much more rapid and certain results. In modern agriculture, while a chemical analysis of the soil is often of great use as a directive agency, there are many other factors to be considered as regards fertility: not only have suitable physical conditions to be present but the materials must be provided for the rapid multiplication of the various living elements on whose activity fertility is now known mainly to depend.

Roughly, each ton of sugar removes from the soil more or less a couple of pounds each of potash, phosphoric acid, nitrogen and lime. In ordinary good soil the top eight inches will contain something like 24,000 lbs. potash, 7200 lbs. phosphoric acid, 11,000 lbs. nitrogen and 50,000 lbs. lime per acre. This should be sufficient for a very large amount of sugar; but the matter is by no means so simple for, as will be emphasized later, the finished product, pure sugar, contains none of these elements, and other forces have to be called in before it can be obtained.

The relative proportions in which the various chemical substances occur in the soil and the condition in which they exist have, together, probably more influence on fertility than the chemical compounds themselves. The physical condition of the soil must be taken into account, and indeed is of paramount importance for the elaboration of food materials by the plant. Every acre of cane land should produce 40-50,000 canes, weighing something like 2 lbs. each, but on how many estates (in the Philippines) is an all round yield of this number obtained?

The texture of the soil is also of importance. This means the relative size and proportions of the ultimate soil particles. We thus can classify soils under the microscope, from such as contain a larger proportion of minute grains 0.005 mm. in diameter to such as have the bulk of the soil particles over 1 mm. in diam., and we call such varying soils clays, silts, sands of different fineness, gravels and so forth. Coarse soils, with larger particles, are poor in moisture retention, soluble foods are easily lost by leaching under rains, the capillary water surrounding each particle is small in amount for the total surface available is also small, but, on the other hand, aëration and free percolation are easy and any vegetable poisons are rapidly got rid of: fine soils resist drainage and retain food

¹A summary of a long paper by C. W. HINES in the *Philippine Agricultural Review*, xi, 4, 1918.

constituents and are therefore much richer, but aëration is difficult and they require much more careful treatment and constant working.

Inorganic matter, which forms the bulk of all soils, is obtained by the accumulation of rock particles often brought from a considerable distance by wind, water or volcanic action. The proportions of these determine the class of soil, but the degree to which these particles have been disintegrated is mainly responsible for the richness of the soil in plant food. But the main factor in fertility lies in the supplies of organic material, which sooner or later has its origin in a great growth of vegetation in the higher regions from which the soil originates. Thus volcanic deposits, especially rich in potash and in good mechanical condition, are capable of supporting great masses of forest, and through these rapid disintegration of the soil mass take place and the deposits, especially when fine in texture are of exceptional fertility. Air and gases, sunlight and water are active agents in this disintegration, hence the importance of aëration in the fields; the

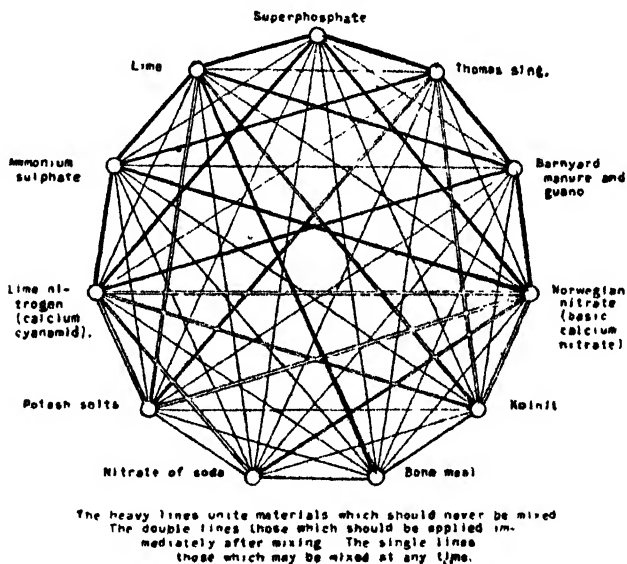


FIG. 1.

organic matter in its decomposition saturates the water with weak organic acids which continuously act upon the rock particles, and hence the importance of constantly adding vegetable matter in some form to the cultivated fields. In certain cases, lastly, great benefit is obtained by the addition of substances not used by the plant as food, such as common salt and gypsum, but their action is rather in the direction of freeing insoluble materials from the rock particles than any direct action on the plant.

Of the many elements used in the building up of plant tissues, four are pre-eminent, phosphorus, potassium, nitrogen and calcium: the substances produced from these are often easily soluble and thus readily available, but this makes it all the more necessary only to apply them in small quantities, or they may be lost by leaching where the rains are good. In the sugar cane most of the elements building up its tissues are obtained from the air and water, only a very small proportion of the plant being mineral matter, but without this percentage it would be impossible to grow the sugar cane at all. This capacity of plants to deal with

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excessively dilute solutions is one of the secrets of their growth; thus, many seaweeds are found to contain large quantities of iodine, but an analysis of sea water shows that this element is present only in negligible quantities. Just as in the human system minute quantities of various substances act as important stimuli, it is probable that the same may be met with in plants, although comparatively little knowledge is at present available on this interesting aspect of plant nutrition outside of the laboratory.

Potassium.—Usually expressed as potash and one of the most soluble of plant foods, but this element is often present in an insoluble form and then applications as manure give excellent results. In fact, because of potash being so often in an unavailable form and thus not easily lost by leaching, soils frequently show large quantities on analysis. The aim of the planter should thus be to unlock these stores, and this can most readily be done by the application of lime, which is much cheaper than potash. The sugar cane plant contains approximately one per cent. of potash and all of this can be returned to the soil, especially in the leaves and the ashes of the bagasse, and when thus returned it is in a readily available form. The exact influence of potash is not fully understood, but its absence induces a yellow colour and slow growth, shrivelled stalks and liability to certain diseases. Its function appears to be mainly connected with the translocation of starch, a very important factor in the building up of healthy tissues. The commonest forms of potash fertilizers are the chlorides and sulphates, the former being especially good where there is much rain, but of less advantage in arid conditions where an accumulation of chlorides may result.

Phosphorus.—This element is present in most soils and in nature is found in great deposits of rocks, in the bones of animals and the ashes of plants. For use in the field the calcium salts of phosphoric acid are used, but these vary greatly in solubility. There are four main classes, technically called mono-, di-, tri-, tetra-calcium phosphates, of which the first alone is soluble. It is in the power, however, of the planter to render the insoluble forms available by proper treatment, and as this is only done gradually there is much less chance of loss by leaching. This disintegration of phosphoric materials may be brought about by aëration of the soil for the provision of oxygen, and by the application of plenty of humus, from which weak acids are developed by bacteria, thus rendering the intractable minerals soluble. It is, however, possible to render the soluble phosphates insoluble, e.g., by the addition of large quantities of lime: care must therefore be exercised in the application of the different manures, and this is best explained by the interesting diagram (Fig. 1) which is appended. If, lastly, proper cultivation is attended to and all the by-products returned to the soil, there should be plenty of phosphorus in an easily available form for the plant's needs.

Nitrogen.—This is the most abundant of plant materials, for it has been calculated that there are 40,000 tons lying ready for use over every acre of land. But this is only rendered available by the action of the various bacteria present in the soil and in the nodules of leguminous roots. This element is the most important for the sugar cane, being indeed the limiting factor for large crops, but it is also the most easily lost by leaching. It is the most expensive and yet the most easily and certainly obtained by a proper system of rotation and the return of the unused parts of the plant. The diagram (Fig. 2) illustrates the path by which the free nitrogen of the air is rendered available for the plant by nature's method, and if this is adopted there is little danger of any loss, because of its continuous, gradual supply. But in no case is it more necessary for the best agricultural practice to be followed, for there are two classes of bacteria present in all soils,

beneficial and harmful. The former require plenty of air and vegetable matter; they live in free oxygen and are therefore termed aerobic; the latter are killed by oxygen and obtain theirs (for all living things must have oxygen) by breaking down the nitrates so methodically built up by the beneficent forms, and forming noxious substances, such as the various nitrites, and ammonia, and dissipating the nitrogen again into the air. The harmful bacteria, however, can only live in such conditions as are bad for growing healthy crops, and can be readily controlled by free working of the soil, good aëration and perfect drainage. But emphasis may here be laid on the necessity of providing the good bacteria with food, for this they must have: while the harmful bacteria feed on nitrates, the useful ones need much vegetable matter in the form of humus, and this may be readily given them by turning in the waste trash which is still so often burnt. The land must also not be sour, and if it is, the acidity must be neutralized by an application of lime.

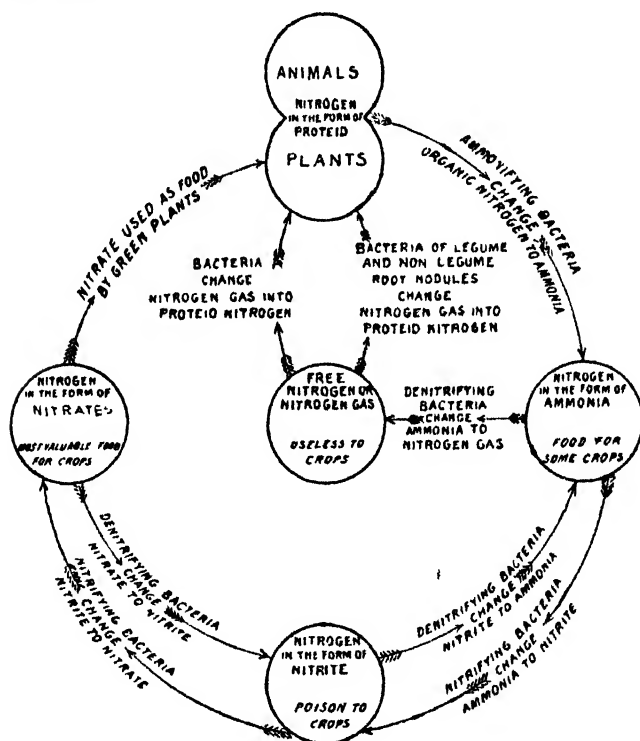


FIG. 2.

Calcium.—This has been estimated as composing one sixteenth of the solid crust of the globe, and is found in rock formations, whether sedimentary, transported or of animal origin (shells, corals, foraminifera, etc.). It is utterly impossible to grow plants without calcium, and it may be used as an oxide, hydroxide or carbonate. Calcium has very important functions connected with the soil, chemical, physical and biological, but it should hardly ever be necessary to apply it directly to the land, if the bagasse ashes and especially the filter-press cake are duly returned. It improves the physical texture of soils, whether of extremely loose character or excessive fineness, in the former case by cementing

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the particles together and in the latter by aggregating the minute particles into larger masses. It neutralizes acids and thus destroys the toxine developed by root action. But a glance at the diagram (Fig. 1) will show that it must be applied with care. It should never be given in quantity with superphosphate, farmyard manure or guano, kainit, bone meal, potash salts or ammonium sulphate: in other words, if it is considered necessary, it should be given at a time when other manures are not usually spread. The oxide and hydrate are specially active and the latter as slaked lime is the more convenient form, while the carbonate works more slowly. The ideal should therefore be to give just enough of the active form for immediate use and the bulk in the form of carbonate which will only gradually become available. Suitable quantities are 200-300 lbs. of lime with a ton to the acre of carbonate.

But to revert, the proper treatment of the soils in any plantation and the best way to unlock the stores of plant food present in all soils will need not only a knowledge on the part of the planter of the way in which such soils have been built up, but constant study of the way in which the different methods of cultivation act and react on its fertility; and one result of such a study will most probably be that the heavy bill for artificial manures will be considerably reduced.

C. A. B.

Sugar Cane Work in Queensland.¹

Mr. EASTERBY is to be congratulated on the prompt appearance of his Report, which summarizes the activities of his department down to October last. It is also satisfactory that he is able to take a more encouraging view of the industry than was the case last year. In reviewing the 1919 Report,² we noted that the general tone was one of doubt, if not of despondency, and all classes in the sugar industry were merely "marking time" until Government should declare its policy. Unless a great improvement took place in the terms on which sugar cane was grown in Australia, it was obvious that the acreage would seriously decline, and the shortage of production with regard to consumption, which had reached 112,000 tons, was likely to be accentuated. The enforced purchase of large quantities of foreign sugar to make up this deficiency has evidently had a great effect, and an equitable arrangement has at last been made by which the cane growers and millers in Queensland are to get some small share of the world's high prices for sugar. The price to be paid for Queensland sugar has been raised from £21 per ton to £30 6s. 8d. (3½d. per lb.) for a period of three years. This agreement has infused a tone of optimism into the current Report; it is stated that the farmers in all directions are planting up old lands allowed to go out of cultivation during the bad years and are also opening up new land; and Mr. EASTERBY estimates that there is at present more land under sugar in Queensland than at any former period. Added to this, the season has opened well, and there is a possibility that the trying cycle of drought years has at last come to an end. With continued good weather it is now probable that all the needs of the Commonwealth will be met locally, and it is indeed possible that there may be a tidy sum of money brought in by export of a surplus.

In an interesting retrospect of the sugar industry for the past 21 years, it is pointed out that there has been a great improvement in the work. During the period 1899 to 1908 it required 9·20 tons of cane to make one of sugar and the average yield in the fields was 14·76 tons; in the second decade, 1909-1918, the

¹ Twentieth Annual Report of the Bureau of Sugar Experiment Stations, Queensland, to the end of October, 1920. H. T. EASTERBY.

² I.S.J., 1920, 219-224.

figures were 8.86 and 17.37 respectively, while in 1920 only 7.76 tons cane were sufficient to produce a ton of sugar. This remarkable result is attributed both to superior mill equipment and to the growing of better varieties in the field; but there is still a considerable margin for further advance, if we look at the cultivation figures brought forward. During the year, out of 1520 reports received from cane farms, only 298 used artificial manure, while 398 practised green manuring and 160 limed their lands. The cane farmers are as a class poor but, with the greater price paid for sugar (of which they are to receive £5 6s. 8d. and the miller £4), it is to be hoped that they will be able to spend more money on improved cultivation, as suggested in the body of the experimental work in the Report.

The year's work in the Experiment Stations is set out in detail. As pointed out in last year's review¹ these stations are situated under widely differing conditions. Bundaberg represents a tract in about 23° south latitude, Mackay in 21° and South Johnstone (Innisfail) in 17°, with a steadily increasing rainfall as well as temperature from south to north. The industry in these tracts differs greatly, and this is brought out in the character of the experimental work on the three stations, but a more serious difficulty is to be found in the position at Bundaberg. It is pointed out that the experimental work at this station is largely upset by frequent frosts and droughts, so that the results are in no way so successful as in the other stations, a disparity which is fully shown in the résumé of the year's lessons.

Southern Experiment Station at Bundaberg.—The rainfall from August, 1919, to September, 1920, was as follows, in inches month by month: 0.76, 0.0, 2.24, 0.55, 0.38, (Jan.) 15.15, 0.51, 1.44, 2.36, 2.37, 2.35, 3.23, 0.27, 1.46, not at all a satisfactory amount in a non-irrigated sugar cane tract. The 15.15 fell in January during a cyclone which caused great damage to the canes throughout the whole coastal tract, especially at Mackay and Innisfail; the remaining 13 months only provided 17.56 in. for the growth of the cane. The following were the chief experiments conducted. (1) *Hand versus machine planting.* The yield for the year was disappointing, only 9½ tons of cane in 22 months' standovers. Summarizing the results accumulated in this experiment during 1917-20 on red soils, there was a slight increase for machine planting. This is, however, sufficient to allay the fears which have been entertained regarding the introduction of this improvement, for the heavy cost of the work was very greatly decreased by the machine. This experiment is now concluded and the plants dug out. (2) *Ordinary cultivation against no cultivation.* This sounds rather curious but is explained by the fact that the red volcanic soils of Woongarra are of so open a texture that the cultivation of the sugar cane adopted elsewhere has proved to be of little benefit. The average of the three years' experiments shows an increase of only 1 ton canes by cultivation: this was in the form of frequent stirring by the Planet Jr. cultivator with duck feet hoes. In the year of drought under report the uncultivated plots gave the better results. This experiment is also closed. (3) *Can cane be grown after alfalfa?* This experiment was initiated because of a widespread belief among the farmers that sugar cane will not grow on red soil which has borne many crops of lucerne. The plots were laid on land under lucerne for 10 years and were in three series, limed and green manured, limed only, and untreated; the last gave the best results, and all were sufficiently satisfactory, considering the prevailing drought, to show that there was no justification for the farmers' prejudice. (4) *Analyses of introduced canes* (from Java, Hawaii, India and Mauritius). A glance at the table of analyses of the juice at 11 months shows remarkably high sucrose content, although it is not suggested that the drought had anything to do with this. Thus one cane, EK¹, had 22.11 per cent. sucrose in the juice, EK² 22.11

¹ I. S. J., 1920, 219-224.

Sugar Cane Work in Queensland.

21.68, three over 20, three others were over 19, and only one each 18 and 17 respectively. All showed low glucose and high purity, EK¹ reaching 94.1, H 109.94 and M 168.4 93.8; only one cane was below 90. Brief botanical descriptions are appended of each kind, a useful feature for comparing their growth with that in other localities. It is interesting to note that Shajahanpur 10, presumably an Indian cane variety, gave 19.74 per cent. sucrose and Yuba 18.91 per cent., results a good deal higher than in their native India.

General Experiment Station at Mackay.—The rainfall during the year was 50.28 in., of which 21.97 in. fell in January but was preceded by a drought in which less than 1.50 in. fell in four months. Naturally, the crops are reported as "not so good as might have been expected." The following were the main experiments: (1) *Comparative trials* (of fifteen of the best New Guinea canes selected from Wells's collection). Analyses of their juice at 8, 9, 10 and 11 months, and crop results for plant canes at 13 months and ratoons at 11 are given. These are generally disappointing, nothing in any way equal to *Badila* or the *Gloria* having been noted. The canes will, however, be allowed to grow as second ratoons. (2) *Subsoiling versus ordinary cultivation*. This was a repetition, at the farmers' request, of an experiment in 1902, when deep subsoiling (to 21 in.) followed by thorough cultivation gave much better results than the farmers got. The figures in tons of cane per acre were 49.6 to 29.6, and in yield of sugar 6.7 to 3.7, in favour of subsoiling: there was also higher sucrose, greater purity, lower glucose and notably less fibre with this treatment. The results of the current experiment conducted for three years supported the former ones, although not in quite such a marked manner, in spite of the cyclone of January when half the canes were destroyed. (3) *Further experiments in subsoiling*. In this experiment the canes were all very well treated (a good deal better than is usual among the farmers), the only difference being in the subsoiling to 7 in. Similar results were obtained, showing that subsoiling is highly remunerative. In the chemical tests among miscellaneous cane varieties it was generally noted that poor juice was obtained, owing to a heavy rain just before the analyses was carried out.

Northern Experiment Station at South Johnstone (Innisfail).—Two checks to growth were experienced during the year. The rainfall, month by month, seems to have been somewhat peculiar in its distribution. During the four months, September to December, only 4½ in. fell, while in the next five over 91 in. out of a total of 108.46 in. for the year were obtained. The experiments on this newly founded station were confined to the testing of varieties from the other stations and elsewhere and trials with fertilizers. Of the most interest were those with canes brought from the hills and planted in the plains. In 1913, when it was thought that some varieties, including the valuable *Badila*, were showing signs of deteriorating, a number of them were sent up to the Kairi State Experiment Station to see if a change to the higher altitude would bring about a rejuvenescence. After six years, during which none of them showed a trace of disease, these were brought down again during the current year and planted at Innisfail. All of them showed a markedly better growth than canes of the new varieties which had not been sent to the hills. This year D 1135, largely grown in the south, is to be sent up.

Careful details are kept at all the stations of the dates of arrowing of the canes grown, and it is interesting to note that, while at Innisfail all of the canes flowered during the year, only five did so at Mackay, whereas none arrowed at Bundaberg, a fact in close agreement with results obtained in India. The work of the Entomological section will be considered in the next issue of this journal.

C. A. B.

Indigenous Stock Feed versus Imported Materials.¹

The question of stock feed on sugar estates has recently become a problem of great difficulty in the Hawaiian Islands because of the conditions created there by the war. Thus far no special attention has been paid to the economy of supplying this material, beyond placing the orders for the importation of the necessary barley, oats, hay, etc. But in spite of the extending use of gasoline driven machinery a good lot of well-fed stock is required on the estates and, in view of the few data obtainable, a Committee was appointed by the Planters' Association to collect information. A comprehensive list is given of the Hawaiian feeds and factory by-products, which shows the great range of choice possible in the islands:—cane tops, molasses, cassava, alfalfa, keawe bean meal are considered in detail and lists are added of other substances under the following heads:—fresh green roughage, weeds, root crops, dried roughage, concentrates.

Cane tops.—The accompanying table gives a comparison of this green feed with sorghum and corn.

	Dry matter.	Crude protein.	Carbo-hydrates.	Fat.	Nutritive ratio.
Cane tops ..	15.8	0.5	9.5	0.3	1 : 20.4
Sorghum	21.0	0.6	12.0	0.4	1 : 21.5
Corn	21.0	0.9	12.0	0.3	1 : 20.8

The tops may be fed as such or made into hay, or fed as cane top meal by passing the dried material through a shredder. In many cases it is cut into small pieces and mixed with molasses or other feeds. The only difference between the green feed and hay or meal is that approximately four fifths of the water has been removed in the latter.

Molasses.—The ordinary waste from the mill is indicated by this term, and its use is recommended because of the low initial cost. The accompanying table shows its food value when compared with barley and corn.

	Dry matter.	Crude protein.	Carbo-hydrates.	Fat.	Nutritive ratio.
Molasses.. ..	74.1	1.4	52.2	0.0	1 : 42.3
Corn	89.4	7.8	66.8	4.3	1 : 9.8
Barley	89.2	8.4	65.3	1.6	1 : 8.2

After a number of years of trial no doubt longer exists as to the value of waste molasses as a useful and effective part of the daily ration. The question of quantity is at present unsettled and must be left to individual experience, but there are apparently no deleterious effects as long as the cattle are well and up to heavy work. It is usually found preferable to give this substance mixed with other food, because of the messy way in which cattle feed when allowed free liquid food.

Cassava and Cassava Meal.—The roots are washed to free them from the outer peel, then chopped small for rapid drying in the sun or artificially, and when dry ground to very fine powder. It is well liked by cattle which do all the work required of them. Although not apparently harmful when administered pure, it is usually preferred to mix this food with others, especially with such as contain much proteid, such as pigeon pea and perhaps alfalfa. The plant is easily grown and does fairly well in dry regions, forming a valuable feed in many localities: it could be grown much more extensively than is done at present. Its food value per 100 lbs. is given in the following table.

Dry matter.	Crude protein.	Carbohydrate.	Fat.	Nutritive ratio.
34.70	0.4	31.2	0.1	1 : 78.5

¹ Report of the Committee on Stock Feed (for the year ending September 30th, 1920), Hawaiian Sugar Planters' Association.

Indigenous Stock Feed versus Imported Materials.

Alfalfa.—Readily grown on most plantations where labour, water and proper cultivation are available. May be used as green roughage or as hay, the latter usually shredded as meal. Hawaiian alfalfa hay compares favourably with imported and the crop could be grown much more largely than it is in most places. On the Grove farm it is, however, being given up, although growing quite well, because too great care is required, making its cost higher than some other green roughages, such as pigeon pea, etc.

Keawe bean meal.—Although this is not always done, it appears to require heat to solidify the gums before grinding. When it can be obtained in quantity, the meal affords an excellent stock feed and it should be a regular ingredient of the daily ration.

Then follows an interesting list of other indigenous Hawaiian feeds under different heads:—

Fresh green roughage.—Sorghum, Para grass, buffalo grass, elephant grass, velvet beans, millet, *Paspalum dilatatum*, Hilo grass, Uba cane (grass), corn and tops, Kaffir corn, Sudan grass, Jack beans, peanuts, Guinea grass, Bermuda grass, cowpeas, pigeon peas, sweet potato plants.

Weeds used as forage.—Honohono, Cactus, pualele (milk weed), and many others.

Root crops.—Cassava, papaias (usually cooked), edible Canna, beets, sweet potatoes, taro peels.

Dried roughage.—Grasses of all kinds made into hay, rice straw, sisal waste.

Concentrates.—Keawe bean meal, pigeon pea meal, Jack bean meal, cowpea meal, coconut meal, molasses, peanut meal, molascuit (molasses and bagasse), rice bran, soy beans, corn and cob meal.

On reviewing the answers received to a questionnaire sent out, the Committee notes a great lack of uniformity in the stock feed given in different places. While it is probably not possible to evolve a standard ration because of the diversity in conditions on different estates, there is no doubt that a great deal of labour might be saved and much more got out of the stock at less cost per head. An example is given, in conclusion, of a daily ration given to mules doing heavy work, which compares favourably with a standard ration of imported food stuffs. These animals were tested for six months with nine hours hard work daily. The standard grain ration was 20 lbs. Californian hay + 18 lbs. grain (half barley and half oats). The local mixture consisted of 40 lbs. green *Panicum*, 3 lbs. molasses and 17 lbs. of the following mixture: 1 to 5 lbs. each, culled velvet beans from refuse of threshing, algaroba meal, alfalfa meal (or equal), peanut plants and pods ground, and corn and corn meal. The culled beans consisted of pods and broken beans after threshing, the peanuts of dried pods, vines and roots ground to meal. This latter proved to be a great favourite, and when placed side by side with cane tops or grain the cattle always went first to the peanut meal. At the end of the six months' trial, the animals fed on the grain ration were run down and had lost weight while those under the mixture had all gained in weight, some to the extent of as much as forty pounds. About thirty pages are appended giving the answers received from various estates.

C. A. B.

The American Bureau of Crop Estimates has given the production of American sugar during 1920 as 1,302,587 short tons, of which the domestic beet crop accounted for 1,109,600 tons.

The Raising of the Sugar Duty in some Continental Countries.

(From our Continental Correspondent.)

Since the beginning of the war the sugar duties have been raised in many European countries, the influence of which measures was not at once felt because of the restricted quantities allotted to the public for the common use and the greatly differing prices at which the industries using sugar as a raw material were obliged to buy what was allowed them.

In France the duty of 27 frs. per 100 kg. of white sugar, dating from the enactment of the Brussels Convention in 1903 was raised in 1917 to 42·50 frs. and in 1920 to 50 frs. In Austria-Hungary the duty of 38 crowns per 100 kg. of white sugar, inaugurated in 1899, was increased in 1917 to 54 crowns for the same quantity, while at this present moment the duty in Austria has remained at that same level, and in Hungary it has been raised to 37 crowns per kg. In Czecho-Slovakia, on the other hand, the duty has been reduced to 24 crowns per 100 kg. In Germany the Government has proposed an increase in the sugar tax from 14 to 100 marks per 100 kg., which project will doubtless be adopted one of these days. In Holland and in Belgium the duties on sugar have remained unchanged since the year 1903.

When in that year the Brussels Convention came into force and consequently the duty had to be paid on the amount of sugar actually consumed and no longer on the basis of a hypothetical quantity to be extracted from the beets worked up or from the diffusion juice obtained, the hidden premiums, occasioned by the difference between sugar charged for and actually extracted, disappeared. The open premiums granted in some countries, where government not only restored the excise but also gave a sum of money in excess on importation, were forbidden, while finally the difference between the duty on home grown sugar and that on exported was restricted to a maximum of 6 frs. per 100 kg. of white sugar.

The abolition of premiums allowed the governments to lower the sugar duties, as thenceforward the total income derived from them could be considered as a profit, while previously an uncertain amount had to be restored to the exporters.

France reduced the duty from 64 frs. to 27 per 100 kg., Germany from 20 to 14 marks per 100 kg., Belgium from 54·30 frs. to 20 frs. per 100 kg., while Holland kept the duty at 27 guilders and Austria-Hungary at 38 crowns per 100 kg.

Owing to the rather small difference between the duty on home grown sugar and on imported, the Kartells in Germany and in Austria-Hungary, which had merged all sugar interests into one powerful body and kept the home price so high that foreign competition was just rendered impossible, were compelled to stop their activity. The artificial raising of the sugar price by the action of the Kartells ceased and for that reason the price of sugar fell considerably both in Germany and in Austria-Hungary. As a consequence of different provisions of the Brussels Convention, the price of sugar for the customer underwent a considerable reduction and the annals of the economic world are full of comments and praise on the greatly increased consumption.

Actually we find that, notwithstanding the greatly reduced duties, the net revenue from them in France, Belgium, Germany and Austria-Hungary, after a short period of decrease, increased considerably over the net amount of those duties before 1903. It is true that in an earlier period a great part of the money collected had been paid back in premiums, and it is equally true that the figures for the sugar consumption in many countries for the years before 1903 were

The Raising of the Sugar Duty in some Continental Countries.

obviously incorrect, being much too low; but it was a certain fact that the general decrease in sugar duties and the falling-away of the Kartell profits stimulated consumption to an unexpected extent. This was so evident that during a certain period it was a kind of an economic creed to believe that every reduction in the sugar duty would be followed by so great an increase in consumption that, after all, the total revenue would be maintained at the old figure.

In 1908 the German Government promised that as soon as the revenue yielded by a few new taxes should bring in 35,000,000 marks over the then existing income, the sugar duty would be diminished to 10 marks per 100 kg., while in France a project of law was brought before Parliament in 1911 aiming at the reduction of the duty from 27 frs. to 15.

These two reductions have never become law, but they show how, as late as 1911, the general tendency of the different European governments was in favour of a steady reduction in the sugar duties, with the obvious intention of stimulating the consumption of so salutary an article of diet as sugar. The sugar consumption followed closely the reduction of the price to the consumer, which proved the truth of the assertions that lowering the sugar duty would increase the use of sugar.

In view of all this, it may well be asked whether the present tendency of the Governments to increase the duty once more (a tendency which we showed at the outset of this article to exist) will not have the contrary effect of reducing the consumption. If the sugar consumption has really been stimulated since the beginning of this century by a reduction in sugar duties, must we not expect a drop in the consumption, when, as is the case now, the duties are appreciably increased?

A Turning Point in the World's Sugar Consumption.

(By our Continental Correspondent.)

Since the year when the sugar production of British India was for the first time incorporated into the world's statistics, the world's sugar production (beet and cane combined) has been as follows expressed in long tons of 2240 lbs. :—

1904-05 .. 12,022,000	1910-11 .. 17,001,529	1916-17 .. 17,096,828
1905-06 .. 14,007,000	1911-12 .. 16,064,391	1917-18 .. 17,422,589
1906-07 .. 14,799,000	1912-13 .. 18,243,235	1918-19 .. 15,858,265
1907-08 .. 13,861,000	1913-14 .. 18,430,873	1919-20 .. 15,222,684
1908-09 .. 14,582,165	1914-15 .. 18,498,498	1920-21 .. 17,302,510
1909-10 .. 14,891,187	1915-16 .. 16,968,003	

From these figures it will be seen that in the first decade of the present century the sugar production of the world oscillated around 14,000,000 tons and, since during so long a period no considerable stocks could have accumulated, the average consumption amounted to a corresponding figure. In the year 1910-11 there was a large increase in production, which was only temporarily interrupted by the disastrous drought in Central Europe of 1911, and it brought the total sugar production up to the astounding figure of 18,498,498 tons in 1914-15, the year in which the last crop preceding the war was sown and reaped.

For numerous reasons which are still fresh in our minds and need not be recapitulated, the European sugar production then decreased wholesale, and the deficit was only partially made good by an extension of the cane sugar production in some countries, among which Cuba was the most conspicuous. The world's total diminished each year, till it attained its lowest point in 1919-20 with 15,222,689 tons. In that year the general feeling was one of sugar scarcity and shortage,

and it led to the phenomenally high prices recorded in the second quarter of 1920. But when comparing this low figure with those of the years composing the first decade of the twentieth century, one observes that it is higher than any one of them, and yet in those years we never heard of a scarcity of sugar.

This fact tends to suggest that if, now, the production of 1920-21 should, as seems probable, revert to the figures of 1910-11 (or only ten years ago), that production will be more than sufficient to cover the demand under the present day prevalent circumstances.

In the years immediately preceding the war, the civilized world was enjoying an unknown prosperity. Consumption of articles, which may, to some extent, be considered as a kind of luxury and among which sugar occupies a prominent place, increased considerably, a fact which may be deduced from the enormous increase in the *per capita* sugar consumption in many a European and American country. Therefore, in the years before the war, the increased sugar production was correspondingly absorbed by consumption, and this was so generally the case that in the calculations made by the sugar statisticians, the question of the consumption was treated as a secondary matter. The figures of production in the various countries were carefully studied and commented on, but it was taken for granted that, as a rule, the sugar produced would find a destination without trouble.

In the war years consumption remained high; the wants of armies and navies necessitated the supply of huge amounts of sugar, both in the shape of sugar for food and beverages as in that for confections, while some sugar also was used in the manufacture of explosives. After the armistice, a spirit of lavishness ensued all over the world, which, delivered from the prolonged oppression of war, indulged in every form of extravagance. The high wages accorded immediately after being claimed allowed wide sections of the population to spend money on extras, and it was remarkable to witness the extent to which grown-up people fed on chocolates, sweets, "acid drops," and the like. The price of the article was not regarded as a hindrance to its being purchased up to the amount allowed by the Government rationing, which in many countries was far above the average *per capita* consumption of the years immediately before the war.

Further, people who during the years of war had witnessed periods of sugar scarcity, during which it was not possible to obtain the quantities which they might desire to purchase, now profited by temporary abundance to lay in stocks, which at once disappeared from view. It looked as though there could not be produced enough to supply the ever-growing desire for sugar, and notwithstanding the fact that immense quantities of sugar, which owing to the blockades and general scarcity of merchant shipping had been held up in foreign countries, now became available, the visible stocks of sugar remained short. It is then no matter for wonder that statisticians neglected the study of consumption and only fixed their attention on the production, the increase of which was the aim and end of everybody concerned.

But during the last half of 1920 the free purchase of sugar by the general public came to an abrupt stop. Sugar was no longer snapped up in the market as soon as it made its appearance, it was even offered in vain; prices showed an inclination to drop, and that precipitated the trouble. The public who, in many cases, possessed appreciable quantities of sugar hidden in their store cupboards, stopped buying and lived on their supplies. The grocers stopped their orders, and the wholesale dealers, who had already contracted large purchases, became overstocked in consequence. Thus all at once, instead of a sugar scarcity, there

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ensued an abundance of sugar (coming from every part of the world) with very restricted purchases and consequently a heavy drop in the price.

By now the invisible supplies will have been consumed, and the public will again have to buy if it wants sugar; but, in the meantime, the general aspect of matters has greatly changed. Instead of high wages and good earnings, unemployment has become the chief factor that rules the budget of the average household. As we have pointed out above, sugar is one of the articles the consumption of which is greatly dependent on the earnings of a large proportion of the population. So long as the wages were high, sugar was bought and used in great quantities, but as soon as more economy had to be practised, it was the first article to be sacrificed.

During January, 1921, the revenue from the sugar tax in France yielded 23,115,000 francs less than that of the corresponding month in 1920, or 25,000,000 francs below estimates. This follows suit with the decrease, reported from the same country in the months of September-December, in which the revenue from that source was 199,315,000 francs in 1919-20 and only 101,213,000 francs in 1920-21. In the last-named period we could still count on invisible stocks being consumed, but as late as January these would have disappeared, so the figure given for January tends to represent the real consumption.

The revenue from sugar in Holland was for January-February, 1921, only 7,274,976 guilders, against 9,680,127 in the corresponding months of 1920. Since a year ago there was no reason at all to suppose an abnormally large consumption, the figure given for January and February, 1921, points to a decrease in consumption in Holland, too. Again, during the ten months April-January, 1920-21, Germany received from the sugar duties 101,963,250 marks, against 140,241,861 marks in the corresponding months of 1919-20. The total yield for 12 months was estimated at 160,000,000 marks, so that the remaining two months will have to supply 58,000,000 marks to reach the estimated figure, which is, of course, quite out of the question.

The same or analogous reports reach us from every part of Europe and show that a general decrease in sugar consumption is the rule everywhere. Finally, we must not forget that Russia, which in former and better years used to consume, aided by her adjacent neighbours, a total production of close on 2,000,000 tons per annum, does not consume now more than the low quantity of its own crippled production, estimated at some 100,000 tons.

We must therefore bear in mind that whereas the sugar production of 1920-21 will attain to about as high a figure as that of 1910-11, one great country, which in the last-mentioned year consumed about 2,000,000 tons, has fallen out almost completely, while the consumption of many others is greatly handicapped. The conclusion to be drawn from all these data is that the day has surely passed for the time being when any amount of sugar produced is sure to find an outlet; and the question of the probable world's consumption will once more have to be taken into earnest consideration.

Mr. F. D. CAIRNS, the Inverness merchant who came into undue prominence during 1919 and 1920 by his repeated attacks in the press on the operations of the Royal Commission for the Sugar Supply, and who claimed that he could easily supply sugar to this country at lower prices than officially ruled, has lately figured in the Bankruptcy Court, his liabilities according to press reports amounting to £1203. It was stated by the Official Receiver in the course of the proceedings that Mr. CAIRNS claimed he was formerly in business in New York as a shipowner and broker, but for the past four years had been acting as the European agent of an American financial syndicate and of a sugar combine having its headquarters in New York and Amsterdam. Mr. CAIRNS had however declined to give him any information regarding the status of this sugar concern.

A Sugar-House Brixometer.

In regard to the determinations required for an accurate control of a cane sugar factory, those of the solids in solution and of the sugar are of equal importance. From these two observations is obtained the "purity" upon which depends the quantity of sugar which can be recovered from that present in the juice extracted by the mills.

Instead of actually determining the solids, it has been customary to determine the specific gravity of the solution and hence to deduce what would be solids in solution provided all had the same influence on the specific gravity as has cane sugar. The solids so determined are called the "apparent solids," the "gravity solids," or the "degree Brix," and DEERR¹ has demonstrated that if in all deter-

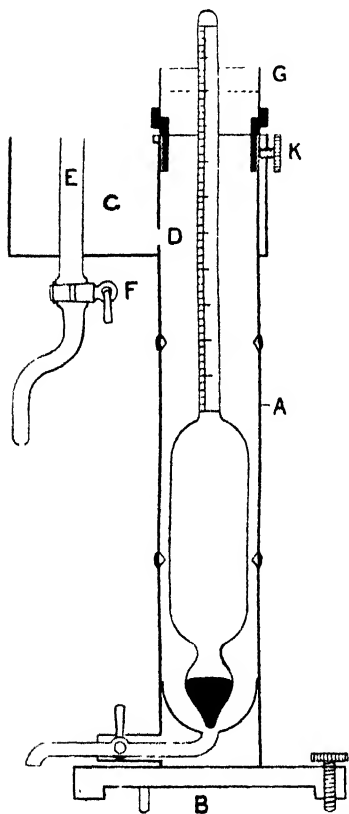
minations a uniform concentration of raw sugars is obtained, the results so found are academically correct.

The determination of the density of solution can be made with very great accuracy by means of the balance; but usually the technical staff found in cane sugar-houses is too limited to afford the requisite time, and therefore resource is had to the simpler operation of gauging the density with a hydrometer specially graduated in Brix degrees.

With the instruments as now made, combined with the opaque nature of the materials to be tested, the accuracy of a determination cannot be guaranteed to less than 0.1° Brix, and such an error may leave the chemist in doubt as to the "availability" of at least half a ton of sugar in every hundred tons received in the juice.

To obtain a greater accuracy with no greater labour, DEERR² devised an instrument,³ which is represented in section in the figure. It obtains its accuracy by transferring the position at which the hydrometer reading is taken from the surface of the liquid to a definite position above the surface; this change of position is combined with a means whereby a very sharp reading can be taken, splitting by estimation the scale division of $\frac{1}{10}$ degree Brix into ten parts and thus affording a

reading to $\frac{1}{100}$ degree Brix. While it is not pretended that so great an accuracy can be obtained, it can at least be said that much greater accuracy than in the usual method is certainly found. A. E. GREVE⁴ in Java reported a series of trials against the balance and pycnometer where the probable error was only 0.023° Brix.



¹ *J.S.J.*, 1913, 365-372.

² *J.S.J.*, 1914, 112-116.

³ Sold by the Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C.3, from whom prices and full particulars can be obtained.

⁴ *Archiv*, 1917, 24, 1-8.

A Sugar-House Brixometer.

Referring to the figure, the instrument is seen to consist of a cylinder *A* on a substantial stand *B*, provided with levelling screws. At the upper portion of the cylinder is arranged a wide portion *C*, which communicates with the cylinder *A* by a hole *D*. In this portion is located a draw-off pipe *E*, terminating at the small cock *F*. The material to be examined is poured into the cylinder either directly or by way of *C* and *D*, whilst it rises to a level above the top of *E*. By opening the cock *F*, and allowing the excess of liquid to draw off, a constant level is secured, the only precaution necessary being to allow the last portion draining to do so drop by drop. The device adopted to secure a very fine reading splitting $\frac{1}{10}$ th of a degree Brix again into tenths, is shown at *G*. It consists of a plain glass cylinder, on which is marked circumferentially a fine line. The glass cylinder sits on a holder capable of up and down motion and of being fixed in a definite position by the set screw *K*. In reading, the position of the eye is adjusted to an exact horizontal position as guided by the continuous index line, and the point at which this seems to cut the stem of the spindle is taken as the reading.

In using the instrument each spindle employed must be graduated once and for all. This may be best done by preparing a solution of sugar and water, and determining its exact degree Brix by the use of the pycnometer and delicate balance. Let such a solution be found to be 15.23° Brix. It is poured into the instrument; the operation of spindling performed; and the reading taken on the line *G*. In order to do this, the glass cylinder is raised and lowered by means of the set screw *K* until the exact reading of 15.23 is obtained on the hydrometer stem. This effects the standardization or rather the setting of the hydrometer once and for all in the case of the particular temperature concerned. The set screw *K* is then locked, and the cylinder emptied and refilled with the juice or other liquid to be examined. The hydrometers supplied with the instrument are so graduated that compared with an ordinary spindle they have an "error" corresponding to about 1.5 cm. above the level of the liquid, so that actually the precise setting is easily effected. It is inadvisable to use an ordinary hydrometer, and apply a constant correction to it, as, unless the bore of the stem is quite uniform, a source of error is thereby introduced.

In the case of readings made at temperatures other than that at which the spindle has been set, using a suitable thermometer (supplied under the Brixometer), a correction must be applied for each 0.1° C. deviation. A temperature correction table is here reproduced for use with spindles graduated for 27.5° C. and with solutions having a density approximately 15° Brix.

Temperature of Observation °C.

	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
Deduct	23 .. 0.21..	0.20..	0.20..	0.20..	0.19..	0.19..	0.19..	0.18..	0.18..	0.18..	23
	24 .. 0.17..	0.17..	0.17..	0.16..	0.16..	0.16..	0.15..	0.15..	0.15..	0.14..	24
	25 .. 0.14..	0.14..	0.13..	0.13..	0.12..	0.12..	0.11..	0.11..	0.10..	0.10..	25
	26 .. 0.09..	0.09..	0.08..	0.07..	0.06..	0.05..	0.05..	0.04..	0.03..	0.03..	26
	27 .. 0.02..	0.02..	0.01..	0.01..	0.00..	0.00..	0.00..	0.01..	0.02..	0.03..	27
	28 .. 0.03..	0.04..	0.05..	0.06..	0.06..	0.07..	0.07..	0.08..	0.09..	0.10..	28
	29 .. 0.10..	0.11..	0.12..	0.12..	0.13..	0.14..	0.14..	0.15..	0.16..	0.17..	29
	30 .. 0.17..	0.18..	0.18..	0.19..	0.20..	0.20..	0.20..	0.21..	0.22..	0.23..	30
	31 .. 0.24..	0.24..	0.25..	0.26..	0.26..	0.27..	0.27..	0.28..	0.29..	0.30..	31
											Add

The necessity for an accurate Brix reading in control is evident from the following calculation. Let the error in the Brix, as usually determined, be 0.1°. If it is a syrup under examination, it is diluted to exactly 15 per cent., and let the

sucrose per cent. of this diluted liquid be 13.2° per cent. In place of 15° Brix let 15.05° be found; the gravity coefficient will be 87.7 instead of 88.0. This would make a difference of about 30 tons in 10,000 in the calculation of the available sugar, which is too large a quantity to neglect. Finally, it may be mentioned that the accuracy in the Brix measurement obtainable with this instrument is only desirable with those determinations on which the rational and serious control of the sugar-houses is based.

Refined Sugar Costs, Prices, and Profits.¹

In a previous report of the U.S. Tariff Commission,² a study was made of the costs of production of raw cane sugar in Louisiana, Hawaii, Porto Rico, and Cuba, and of beet sugar in America. This present report treats of the refining of sugar in the United States on a similar plan. It also describes the activities of the United States Government through its several agencies, the Food Administration, the International Sugar Committee, and the Sugar Equalization Board, in regulating the price and distribution of sugar. Further, the effects of the several attempts at combination upon prices and profits are discussed. An enquiry is also made in regard to the influence of the tariff on combination, and to what extent changes in rates of duty have affected prices and profits.

Table 6 which is produced opposite summarizes the more important statistical data collected. In regard to the profits and returns on productive investment, it is remarked that in every year the profits when obtained by the method of averaging by refineries are less than when obtained by the method of averaging by poundage. Such a result suggests economy in large scale production; but by whichever method the average is obtained the profits are moderate until 1917. Averaging by poundage, the returns on productive investment are 8.64 per cent. in 1914; 7.19 per cent. in 1915, and 7.51 per cent. in 1916; and averaging by refineries they are even less, 6.16 per cent., 5 per cent. and 1.11 per cent., for the same three years respectively. With 1917, however, profits make a sudden advance. When averaged by refineries, it is seen that from less than 2 cents on 100 lbs. of sugar in 1916 they jump to over 40 cents on 100 lbs. in 1917. When averaged by poundage, the advance is not so great—from about 14 cents per 100 lbs. to over 52, but still great enough to be startling, representing as it does a return of over 28 per cent. on productive investment and an increase over the preceding year of 276.2 per cent. Moreover, this advance is made in spite of writing a generous portion of current income to depreciation. From about $1\frac{1}{2}$ cents per 100 lbs. charged to depreciation in 1916, this charge was increased to 6 in 1917, an increase of 361.5 per cent.

In 1918 profits returned to about the level of 1914. Averaging by refineries they were 10.6 cents per 100 lbs. in 1914, and 13 cents in 1918. Averaging by poundage they were 15.9 cents in 1914 and 19.1 in 1918. On the surface this looks like a considerable advance, but considering the decreased purchasing power of money, as shown by index numbers, profits appear to have been actually less in 1918 than in 1914. In 1919 there was again a sharp advance in profits to a level much higher than normal, but not quite so high as in 1917. Averaging by refineries they are 21.6 cents per 100 lbs., and by poundage 36.4. Perhaps the

¹ Extracted from Tariff Information Series, No. 16, U.S. Tariff Commission, 1920; 43 pages. (Government Printing Office, Washington.) Price: 10 cents.

² Tariff Information Series, No. 9; see *I.S.J.*, 1919, 215.

TABLE 6.—Averages, by refineries and by poundage,* for 12 refineries, showing the several items of the cost of refining sugar, for the years 1914-1919.
(Averages expressed in cents, per lb.)

Items of Cost and Price.	1914.			1915.			1916.			1917.			1918.			Six months of 1919.		
	Average by Refineries.	Poundage.		Average by Refineries.	Poundage.		Average by Refineries.	Poundage.		Average by Refineries.	Poundage.		Average by Refineries.	Poundage.		Average by Refineries.	Poundage.	
Price of raws per lb. of raw	3.520	..		4.541	4.527	..	5.610	5.618	..	6.022	5.893	..	6.219	6.260	..	7.203	7.213	..
Cost of raws per lb. refined..	3.735	3.717	..	4.853	4.803	..	5.969	5.868	..	6.480	6.320	..	6.693	6.717	..	7.696	7.698	..
Total refinery cost	0.431	0.420	..	0.418	0.424	..	0.453	0.452	..	0.669	0.713	..	0.931	0.961	..	0.866	0.869	..
Items of refinery cost:—																		
Labour	0.105	0.102	..	0.106	0.107	..	0.126	0.127	..	0.177	0.160	..	0.273	0.272	..	0.237	0.248	..
Fuel	0.060	0.050	..	0.051	0.044	..	0.058	0.048	..	0.097	0.104	..	0.126	0.129	..	0.117	0.124	..
Bone char	0.012	0.010	..	0.011	0.010	..	0.010	0.009	..	0.015	0.015	..	0.018	0.019	..	0.017	0.017	..
Repairs and Maintenance	0.024	0.021	..	0.021	0.019	..	0.022	0.020	..	0.060	0.067	..	0.041	0.042	..	0.041	0.043	..
Containers	0.132	0.132	..	0.136	0.140	..	0.129	0.141	..	0.182	0.192	..	0.291	0.294	..	0.299	0.305	..
Depreciation	0.012	0.013	..	0.012	0.013	..	0.012	0.013	..	0.045	0.060	..	0.027	0.047	..	0.038	0.046	..
Other refinery costs ..	0.086	0.092	..	0.081	0.091	..	0.096	0.094	..	0.093	0.115	..	0.155	0.158	..	0.107	0.107	..
Marketing costs	0.089	0.080	..	0.092	0.086	..	0.102	0.092	..	0.070	0.084	..	0.092	0.086	..	0.104	0.100	..
Receipts for by-products ..	0.654	0.056	..	0.065	0.075	..	0.083	0.098	..	0.134	0.154	..	0.194	0.215	..	0.128	0.170	..
Total, not including raws..	0.466	0.444	..	0.445	0.435	..	0.467	0.446	..	0.605	0.643	..	0.829	0.832	..	0.832	0.819	..
Total, including raws	4.201	4.161	..	5.298	5.238	..	6.436	6.314	..	7.085	6.963	..	7.522	7.649	..	8.528	8.517	..
Price of refined	4.307	4.321	..	5.384	5.371	..	6.455	6.453	..	7.550	7.486	..	7.662	7.740	..	8.844	8.881	..
Profit	0.106	0.160	..	0.086	0.133	..	0.019	0.139	..	0.465	0.523	..	0.130	0.191	..	0.316	0.364	..
Refiners' margin	0.787	0.791	..	0.843	0.844	..	0.945	0.935	..	1.528	1.593	..	1.433	1.490	..	1.641	1.668	..
Investment per lb. refined sugar	al.72	al.85	..	al.72	al.85	..	al.72	al.85	..	1.72	1.85	..	al.72	al.85	..	al.72	al.85	..
Percentage return on productive investment represented by profits ..	6.16	8.64	..	5.00	7.19	..	1.11	7.51	..	27.0	28.3	..	7.56	10.32	..	18.37	19.67	..
Average price 96° centrifugals, N. Y. quotations..	—	3.814	..	—	4.642	..	—	5.786	..	—	6.228	..	—	6.447	..	—	67.61	..
Average price refined granulated, N. Y. quotations.	—	4.683	..	—	5.559	..	—	6.892	..	—	7.663	..	—	7.834	..	—	69.00	..
Refiners' margin from N. Y. quotations	—	0.869	..	—	0.917	..	—	1.076	..	—	1.435	..	—	1.387	..	—	61.38	..

(a) Computed from 1917 data.

(b) The averages for 1919 were obtained from weekly quotations, Willett & Gray. The price fixed by the Board of Equalization (7.26 for 96° centrifugals and 9 for refined granulated) prevailed throughout the year, except that the last three quotations for new crop Cubas (December 18th, 24th, and 31st) were 13.95, 18.04, and 12.19 respectively.

(*) Averages by refineries were obtained by adding the costs, per lb. of sugar refined for each refinery and dividing by the number of refineries. Averages by tonnage were obtained by adding the total outlay in dollars for the several items of cost for each refinery, and dividing by the total output of refined sugar for all the refineries. The average by refineries is thus the average cost to the several refineries, regarding each refinery as an indivisible unit. The average by poundage is the average cost at which sugar is refined, regarding the lb. of sugar as the unit. The cost of all the lbs. irrespective of refineries, is divided by the number of lbs. refined.

most instructive way of studying the fluctuations of profits during the war period is to consider them in terms of the percentage return on productive investment. Such a comparison is made in Table 8:—

TABLE No. 8.—*Average profits in the years specified, expressed as percentage of productive investment.*

Average by ..	1914		1915		1916		1917		1918		1919
Refineries....	6.16	..	5.00	..	1.11	..	27.0	..	7.56	..	18.37
Percentage ..	8.64	..	7.19	..	7.51	..	28.3	..	10.32	..	19.67

In an average by poundage the costs or profits of the large refineries have a greater weight in determining the average cost or profit than the small refineries, while in an average by refineries all refineries have the same weight. Hence the average cost or profit by poundage tends to conform to the cost or profit of the large refineries, while in the average by refineries there is no such tendency. It follows, then, that if, when averaging by percentage the cost is smaller or the profit larger than when averaging by refineries, the inference is that there is economy in large-scale production.¹

Studying the averages in the light of this principle, it will be seen that there is no very marked tendency in favour of the large refinery—certainly no such marked tendency as is observable in the case of the manufacture of raw sugar.² Taking cost of raws the evidence is in favour of the large establishment in 1914, 1915, 1916, and 1917, but not in 1918 and 1919. Taking refinery costs the evidence is in favour of the smaller establishments in every year except 1914 and 1916. Taking marketing costs the evidence is for the large establishments in 1914, 1915, 1916, 1918, and 1919, and for the small establishments in 1917. Taking receipts for by-products the evidence is decidedly for the large establishments in every year. It thus appears that taking the items of cost separately the evidence is inconclusive, but when all of these items are combined and deducted from the price, thus obtaining the profit, the evidence points strongly to the advantage of the large establishments. For every year the average by poundage is distinctly larger than the average by refineries.

A more detailed study of costs and prices than can be made without revealing the identity of individual factories would seem to confirm for the refining industry the economic concept of an optimum size, i.e., that the economies of large-scale production prevail up to a certain point, after which there is little or no gain in increasing the size of plant.

Again there is internal evidence that in considering the economies of large-scale productions, it makes a difference whether the large-scale production was attained under competition or in an effort to secure monopoly. The promoters of the former sugar monopoly in order to induce competing establishments to come into the combination appear to have made concessions to some of the competitors, which resulted in incorporating in the "trust" units of comparatively low efficiency. Hence, from a business point of view, however much this may have been justified by monopoly profit, it was not justified by that form of profit which flows from the economy of large-scale production.

¹ The inference may not be justified. If some other circumstance is always present with the large establishments which is absent from the small establishments it may be this other circumstance which is the cause of the economy and not the scale of production. The sugar factories of Cuba average much larger in size than those of Louisiana and also show a much lower average cost of production. But in this case the lowness of cost is due to the fact that they are situated in Cuba rather than to the fact that they are large. Nevertheless, where no such universal concomitant is discoverable, the inference may be accepted.

² See "Cost of Production in the Sugar Industry."—*Loc. cit.*

Data concerning the Advantages, Production, and Cost of "Natilite" Motor Fuel.

II.

"NATILITE" (EXTRACTS).

Molasses has been used from the early days of cane sugar manufacture for the production of alcohol in the form of rum. In the West Indies, particularly in Jamaica, Trinidad, Barbados, Demerara, Martinique, and Guadeloupe, the industry of rum manufacture is an important one, and this produce has still a reasonably profitable market. In most other countries, generally speaking, the business hardly attains the same dimensions, and is less certain in character. Indeed in some places it may be regarded almost as speculative, since the operation of the distillery forming an adjunct to the sugar factory proves at times unremunerative, and may be closed for a period until market conditions make it worth while again to utilize the waste product in this manner. In certain countries in which formerly a greater amount of spirit was produced than at the present day, the question of the disposal of the molasses has become an acute one; and elsewhere it presents a problem which has always awaited a solution.¹

After what has been stated in the previous article on the imminence of a petrol or gasoline famine, owing to the depletion of the world's supplies of crude petroleum,² there appears to be little doubt that the co-operative production of alcohol for the production of "Natilite" is a particularly attractive scheme for the establishment of a lucrative branch of the cane sugar industry. Plants for the production of "Natilite" at suitable centres would result in the absorption of the factory waste molasses in modern distilleries, giving a good yield, and showing an excellent margin of profit, which in all probability would steadily increase as the price of petrol or gasoline rose, as would seem inevitable in view of the "permanent world famine" of this commodity, of which according to the British Board of Trade³ there is a grave danger.

Such plants may already exist for the production of rum, and may require little modification for the manufacture of 96 per cent. spirit and ether. In regard to the preparation of the ether which is mixed with the alcohol to form "Natilite," this only necessitates a comparatively inexpensive installation, since the procedure involved is simply to treat the alcohol with concentrated sulphuric acid, and distil off the ether thus formed by the dehydrating action of the acid upon the alcohol.

It seems therefore clear that cane sugar manufacturers should find the operation of central "Natilite" plants at various suitable locations a business proposition of great interest for the conversion of their waste molasses to motor spirit. However, as we have already reminded our readers,⁴ the entire amount of molasses available in many countries may be insufficient for the production of the total quantity of spirit demanded, if not at first, at any rate later. In anticipation of this contingency, other sources of raw material must therefore be considered.

RAW MATERIALS FOR "NATILITE" PRODUCTION.

Raw materials for the production of alcohol may be divided into two classes: (1) *Saccharine materials*, including molasses, sugar cane, sorghum, and sugar beet, in which the fermentable sugars are already formed; and (2) *Starchy materials*

¹ Thus PRINSEN GEERLIGS remarks in his "Cane Sugar and its Manufacture," page 350: "The question how to use molasses in countries where the transport of 'Molasecult', rum, etc., to other countries is too expensive is therefore still unsolved; and generally the only way of getting rid of this troublesome by-product is to throw it into the nearest stream."

² *I.S.J.*, 1921, 117 *c* seq.

³ *The Times*, March 2nd, 1920; *I.S.J.*, 1921, 148.

⁴ *I.S.J.*, 1921, 152.

including cereals (as sorghum grain, rice, maize), and tubers (as cassava, sweet potatoes, arrowroot, etc.), in which starch is the carbohydrate present. In the first class of materials, fermentation is directly effected by the yeast; but in the second the starch must first be converted by suitable means (to be mentioned later) into fermentable sugars. It is proposed now to give information regarding the production of alcohol from these various materials that will be of service to planters considering the installation of a "Natilite" central. Space is not available for entering closely into the technical details relating to the operation of fermentation and distillation; nor is this necessary at this time, the purpose of this article being to present sufficient general data to convince those interested of the desirability of co-operating in the production of industrial alcohol and ether for fuel purposes.

(1) *Saccharine materials*.—Cane molasses unquestionably surpasses any other material for the manufacture of alcohol for two reasons, the first being that it is comparatively rich in fermentable sugars, and secondly it is a waste product in many countries. Complete statistics regarding the amount produced in different parts of the world do not appear to be available, though figures for certain territories have been published. Factory control figures, however, indicate that the weight of molasses averages about 25 per cent. of the weight of raw sugar produced, being sometimes a few per cent. above or below, depending upon several factors, principally upon the degree of exhaustion of the molasses. At any rate, 25 per cent. may be accepted as a sufficiently close figure for the calculation of the amount of molasses available in any country.¹ Calculated as dextrose, the total fermentable sugars (sucrose and "glucose" or reducing sugars) present in cane molasses vary rather considerably, namely from about 52 to 62 per cent., but the actual composition to serve as a basis of calculation must be determined in the case of the product of the particular district concerned. Probably 57 per cent. may be taken as a very fair average figure.

Cane cultivated as a raw material for alcohol manufacture would contain 12-18 per cent. of total sugars as dextrose, and the juice extracted by a distant mill, perhaps after the sugar manufacturing season had terminated, might be conveyed to the "Natilite" central by pipe line. Sorghum stalks contain about 13-14 per cent. of total fermentable sugars, and at least 80 per cent. might be extracted in modern mills situated at different points in the territory, the juice obtained being also conveyed to the fermenting vats in the "Natilite" central by pipe line, a system of transporting juice which is now in use in several sugar-producing countries, and proved to be quite practicable.²

Sugar beets might be cultivated in certain countries, and the better varieties would contain 12-15 per cent. of fermentable sugars, of which it should be possible to extract at least 90 per cent. in a special diffusion apparatus used in distilleries in France and elsewhere.

(2) *Starchy materials*.—Sorghum grain contains about 66 per cent. of starch; rice, about 67; maize, about 63; cassava, about 25 per cent.; and sweet potatoes, about 22 per cent. of starch and 5-6 per cent. of fermentable sugars. All these plants might be cultivated in tropical countries for the purpose in view.

SACCHARIFICATION OF THE STARCHY MATERIALS.

It has already been pointed out that starch cannot be fermented by yeast directly, but requires preliminarily to be hydrolysed to simpler saccharides. In

¹ Figures for Hawaii show 25.5 per cent. See *I.S.J.*, 1921, 156.

² *Cf. I.S.J.*, 1919, 411.

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the production of spirit at the present time, this is accomplished largely by the malting process, in which the starchy material after mashing is cooled to 50-55°C., and mixed with green malt. In this way, by means of the enzyme diastase, the starch is converted to maltose and malto-dextrins, which are capable of being fermented by the yeast. Another process that is used to some extent, especially on the Continent, is to heat the mash (often under pressure) with about 2½ per cent. of hydrochloric or sulphuric acid, which later is neutralized.

During recent years, however, an improved method of converting starch has developed, and is now successfully used in large distilleries in France, and elsewhere. This is the so-called "amylo process," which takes advantage of the fact that certain moulds secrete amylase or diastase. Originally, the mould employed was *Amylomyces Rouxii*, this designation giving rise to the name by which the method is now known; but it is to be noted that a special culture mould has now been put into use, *Mucor Boulard*, No. 5, which effects the conversion of the starch to fermentable sugars, both rapidly and efficiently.¹ This process is well suited for use in tropical distilleries, and from the technical point of view offers distinct advantages compared with the acid process, in respect of economy both of steam and labour; while compared with malting, the operation of conversion is simpler, and is more certain and more rapid, and generally more suitable for tropical climates. Furthermore, it is claimed that the conversion by means of these cultures is very complete, practically all the starch of the raw material being converted into fermentable sugars.

FERMENTATION AND RECTIFICATION.

Under this heading, it may be pointed out that according to modern practice in fermentation the aim is to obviate the growth of any micro-organisms that may cause the formation of products other than ethyl alcohol. This is ensured by the use of pure yeast cultures,² the presence of foreign noxious micro-organisms, such as butyric acid bacteria, acetic acid bacteria, mycoderma, etc., causing a low yield of alcohol being carefully suppressed. It is unnecessary here to enter into intimate details regarding the use of pure yeast, this being a matter that may well be left in the hands of the up-to-date distillery superintendent; but in order to emphasize the importance of conducting operations on these lines, attention may be directed to certain figures given by J. MAGNÉ³ in regard to the yield of alcohol under different conditions of working:—

METHOD OF FERMENTATION.	YIELD OF ALCOHOL, PER CENT. OF THE THEORETICAL.
Spontaneously, in the presence of wild yeasts	40-60
Using compressed yeast	50-75
Adding antiseptic chemicals	70-85
Operating with pure yeast	85-95

Regarding the distillation and rectification of the fermented mash, it may be remarked that the purpose of this stage of the manufacture of "Natilite" is to produce a spirit containing 96 to 98 per cent. of alcohol (by volume). Most of the alcohol nowadays is distilled in so-called "patent stills," equipped with a rectifying column, of which the Coffey type is the most prominent example. These apparatus are highly efficient, and are capable of producing spirit continuously at 96 per cent.⁴; whereas with the old plant of the pot still type the strongest alcohol obtained is only about 92 per cent., even by repeated distillation.

¹ Cf. *I.S.J.*, 1919, 255; 1920, 289; also U.K. Patent, 16,198 of 1914. But it is as well to point out that it is a process that requires very careful supervision.

² *I.S.J.*, 1918, 421-424.

³ *I.S.J.*, 1919, 466; 1920, 461.

⁴ As made by Messrs. Blair, Campbell & McLean, Ltd., of Glasgow; MM. Egrot and Grangé, of Paris; and MM. Barbet & Fils & Cie, also of Paris.

YIELDS OF ALCOHOL FROM VARIOUS MATERIALS.

From what has now been stated, it will be gathered that technically the production of alcohol for "Natilite" is carried out by a series of operations that presents no difficulty in practice, either in the tropic or elsewhere. As compared with most other manufacturing operations, in fact, operating expenses (as those involved in labour, fuel, depreciation of plant, etc.) are quite low.

It now remains to summarize a few further figures that may be of service to those considering the erection of a "Natilite" central, particularly in calculating the yield and profit to be expected. It is impossible in practice to obtain a complete conversion to alcohol of the sugar present in molasses or other raw material, as is well known. Theoretically, the yield of absolute alcohol by weight would be:

	PER CENT.
From dextrose	51.1
„ sucrose or maltose	53.8
„ starch	56.8

These theoretical values, however, are never reached in practice; but in efficient plants under careful management a yield of 85-90 per cent. of the theoretical amount should be obtainable.

In the following table is given the approximate yield of alcohol that may be expected from various raw materials, some of the figures shown being actually obtained in large scale operation:—

Material	Imperial gallons of Alcohol (95 per cent) per ton of 2240 lbs.	Material	Imperial gallons of Alcohol (95 per cent) per ton of 2240 lbs.
Sugar molasses	65	Artichokes	22
Sorghum stalks	12½	Cassava	39
Wheat	83	Apples and pears	12
Barley	70	Apricots and peaches	11
Maize	85	Grapes	18
Sorghum grains	87	Bananas	13
Potatoes	20	Zamia palm (<i>Macrozamia</i>)...	18
Sweet potatoes	35	Grass-tree (<i>Xanthorrhoea</i>) ..	12
Sugar beet	18	Sawdust (soft woods)	20

(To be continued)

Dr. KOHLER, of the Universal Film A.G., at a recent conference of the German Engineering Society, exhibited a film showing the formation and growth of crystals, which revealed clearly the mechanism of the process. A crystal growing in a saturated hot mother liquor absorbs the dissolved matter like a sponge, but in quite definite proportions, in order to use it for the formation of its surface. In a liquid which is practically completely at rest, each crystal fragment is surrounded by a layer of unsaturated solution, which must be uniformly renewed if the crystal is to grow uniformly and free from distortion. One of the first requisites for such a crystallization is that the cooling of the liquid must exactly keep pace with the speed of the crystal formation. The formation of the dilute layers which surround the crystals is, naturally, rendered more difficult by diffusion, which in this case seeks to establish equilibrium between the supersaturated, saturated, and unsaturated zones. By imparting to the crystallizing liquor a slight though uniform motion, the distribution of the dilute zone round the growing crystal can be aided. Such a motion should just suffice to gently agitate the liquid, while not causing any appreciable alteration in general concentration. The excellent results that have been obtained from crystallization in motion promise an extended practical application for the method. The crystals thus formed are often characterized by their slightly rounded angles and edges. Since the speed with which the diluted zone forms near the crystal varies with the nature and special properties of the crystallizing material, so must the time of oscillation depend upon the same factor.

The Application of the Clerget Method to Dilute Sucrose Solutions.

By RICHARD F. JACKSON and CLARA L. GILLIS.

A short article¹ entitled "An Inherent Error in Certain Modifications of the Clerget Method of Double Polarization" has recently been published by C. A. BROWNE. He briefly discusses the validity of the methods of Clerget analysis which we have elaborated in a recent publication of the Bureau of Standards.

In the following discussion we shall show: (1) that Dr. Browne's criticism is invalidated by a disregard of the fundamental principles of the Clerget analysis; and (2) that the modified method proposed by us gives a sucrose analysis of high precision.

Dr. Browne's criticism is directed mainly at the method of neutral polarization in which the hydrochloric acid is neutralized by ammonia or sodium hydroxide, and an exactly equal quantity of the neutral salt added to the direct polarization, the two polarizations thus being made under similar conditions.

He points out that while the value of the rotation of sucrose in the presence of 3.392 grms. ammonium chloride is 99.43° S for the normal sucrose solution, the depressive effect of the salt is progressively diminished in diluted sugar solutions, the rotary power tending to return to its normal value in pure aqueous solution. Thus, he concludes, the positive constituent of the Clerget divisor, under the conditions assumed, is not a constant quantity.

Although for the original suggestion of the neutral double polarization method we are indebted to SAILLARD,² he has never elaborated the method to the extent of actually determining the constants or studying in detail its operation. We now answer Dr. Browne's criticism in so far as it applies to our own contribution.

In presenting the criticism as stated above, Dr. BROWNE has apparently overlooked the fundamental principle on which the Clerget analysis is based, namely, that the measure of the sucrose is neither the direct nor invert polarization, but is solely the algebraic difference between them. He points out that as the dilution of sucrose increases, the specific effect of the ammonium chloride decreases and the sucrose tends to return to its normal rotary power in aqueous solution. Obviously, if this is true for the direct polarization, it is equally true for the invert polarization. In order to emphasize this, we point out that the rotation of invert sugar in the presence of 3.392 grms. NH_4Cl is -33.91 and in pure water is -32.00 . Thus, while the rotary power of sucrose in the presence of ammonium chloride is increased in dilute solution, on exactly the same principle the negative rotary power of invert sugar is diminished in dilute solution. Hence the effect of ammonium chloride is compensating in the two polarizations. Consequently, all the requirements of the Clerget analysis are satisfied, provided this compensation of effects is quantitative.

There are two ways of determining whether the compensation of effects is quantitative. The first way would be to measure the specific effect of ammonium chloride on dilute sucrose solutions and on dilute invert sugar solutions respectively, and to ascertain whether or not they counterbalance each other. The

¹ *I.S.J.*, 1921, 186

² Scientific Paper, Bureau of Standards, No. 375, 1920; *I.S.J.*, 1920, 509, 570 and 638.

³ *Communications, Eighth International Congress of Applied Chemistry*, Vol. 25, 541; *I.S.J.*, 1912, 578; also 1914, 39.

measurement of this effect on invert sugar at high dilution and the disentangling of it from the other effects arising from the behaviour of invert sugar with respect to temperature and concentration would indeed be an experimental task of some magnitude. And yet this is exactly what Dr. BROWNE would have been compelled to do if he had followed his reasoning to its logical conclusion. He has, however, completely overlooked the effect on the invert polarization. Any conclusion based on his reasoning must therefore be considered invalid.

The second method of showing whether the compensation of effects is quantitative is the very simple expedient of trying it out on known solutions of pure sucrose. We will then obtain directly the quantity with which we are concerned, namely, the resultant of the dilution effects.

That the effect to which Dr. BROWNE calls attention is small appears at once from his polarizations of sucrose. Thus in the presence of 3.392 grms. ammonium chloride the rotation of 5 grms. of sucrose, if strictly proportional to concentration, would be 19.12°S , while Dr. BROWNE finds it 19.17°S . Here is then 0.05°S in the direct polarization to be compensated by a similar effect in the invert polarization. We have selected for this comparison the most extreme dilution to which Dr. Browne's direct polarizations have been carried. The magnitude of this quantity (which divided by the Clerget constant becomes 0.04°S) is less than the accuracy with which the average analysis is made in the usual application of the Clerget method.

Now let us consider how much compensation we may expect in the invert polarization. We reproduce in Table I the rotations of sucrose and of invert sugar in pure water solution and in the presence of the respective reagents which are employed in our proposed methods of analysis.

TABLE I.

Influence of Reagents on the Rotations of Sucrose and of Invert Sugar

REAGENT ADDED TO NORMAL SOLUTION. GRMS.						SUCROSE DEGREES S	INVERT SUGAR. DEGREES S.
None	..	..	..	..	....	100.00	— 32.00
3.392	NH ₄ Cl	..	..	..	..	99.43	— 33.91
3.636	NaCl	..	..	..	....	99.05	— 34.00
2.315	NaCl	..	..	..	..	99.38	— 33.25
2.312	HCl	..	..	..	....	—	— 33.25

The following arguments apply not only to the inorganic reagents employed in our Method 2 (Direct Polarization + NH₄Cl; Invert Polarization + NH₄Cl), but also in Method 4 (Direct Polarization + NaCl; Invert Polarization + HCl), and to the inorganic constituents of sugar-house products. In these methods¹ we have specified that the two polarizations shall be made in the same concentration of the sample.

Confining our attention to the respective rotations of sucrose and of invert sugar in pure water and in the presence of 3.392 grms. ammonium chloride, we see at once that the influence of this salt is much greater on the rotation of invert sugar than it is on sucrose. We would therefore be led to expect that any change in this quantity arising from dilution of invert sugar would be greater in the case of invert sugar than in the case of sucrose. In other words, the question lies not in the change in the direct polarization as Dr. BROWNE contends, but in the very obverse of it, i.e., whether the compensation for this change in the invert polarization is not too great. Consequently, we point out that we have in the construction

¹ Scientific Paper, Bureau of Standards, No. 375, 184-189, *I.S.J.*, 1920, 638-643.

The Application of the Clerget Method to Dilute Sucrose Solutions.

of our methods made the positive constituent of the Clerget divisor standard at the normal weight of 26 grms. in 100 c.c., i.e., our direct measurement of the positive constituent was made at this concentration. On the other hand, our direct measurement¹ of the rotation of invert sugar in the presence of ammonium chloride was made at the concentration 15.5 grms. of sucrose (inverted), which is midway between the extremes 26 and 5 grms. Thus, the expectedly greater effect in the invert polarization is diminished by the fact that the extremes of concentration are nearer the standard concentration. An estimate, based on a graph of Dr. Browne's data and on the assumption that the effect of dilution is the same in both polarizations, leads us to the conclusion that whatever lack of perfect compensation remains involves the third decimal of the per cent. sucrose with a maximum effect of one or two units in the second decimal. This reasoning is not reproduced here because certain assumptions are involved which would require for verification polariscopic measurements with a precision beyond our present possibility. A much better method of study would be to abandon Dr. Browne's method of attack and turn to analytical results.

In corroboration of the theoretical considerations outlined above, and in order to show the complete adaptation of the modified Clerget method to dilute sucrose solutions, we have performed analyses on solutions of known sucrose content by the respective methods proposed by us in our previous communication. The analytical data are assembled in Table II. Since the question at issue is the behaviour of pure sucrose in dilute solution, no impurities have been introduced. The two polariscope tubes containing the solutions for direct and invert polarizations were placed side by side in a rack connected with the Bates' saccharimeter, their water-jackets being fed with water from a nearby thermostat. The direct polarization P and invert polarization P' were then observed in close succession on the same scale of the instrument, no particular attention being given to the zero point of the instrument. The interval $P - P'$ was thus observed directly and the scale correction applied to this interval. Each of the authors made a complete series of readings with numerous settings of the instrument.

TABLE II.

Analysis of Dilute Solutions of Pure Sucrose by the proposed methods.

Method.	Sucrose per 100 c grms.	P-P' Deg. S.	Tempera- ture Deg. C.	Cor- rected Divisor	Sucrose found percent.	Sucrose taken percent	Error.
I. — 75 c.c. sol. for P and P'	6.9264	35.280	20.32	132.56	26.61	26.64	- 0.03
I. — Ditto do. . . .	7.0176	35.764	20.23	132.59	26.97	26.99	- 0.02
II. — Ditto do. . . .	6.4624	33.020	20.22	132.68	24.89	24.86	+ 0.03
II. — Ditto do. . . .	4.9513	25.263	20.17	132.67	19.04	19.04	0.00
II. — Ditto do. . . .	3.0059	15.290	20.21	132.49	11.54	11.56	- 0.02
IV. — Ditto do. . . .	6.9264	35.163	20.33	131.94	26.65	26.64	+ 0.01
IV. — Ditto do. . . .	5.2561	26.693	20.15	131.93	20.23	20.22	+ 0.01
IV. — Ditto do. . . .	3.0382	15.330	20.27	131.75	11.64	11.69	- 0.05

Mean Error = - 0.01

In Table 3 we include two analyses, the first of which is one of five published by Dr. BROWNE² for the sole purpose of showing the defects of the Clerget method when applied to sucrose-invert sugar mixtures. The analysis selected for

¹ *Scientific Paper, Bureau of Standards, No. 375, 172, table 14.*

² *J. Assoc. Off. Agr. Chem., 1916, II, 138; J.S.J., 1917, 139.*

this comparison is the one which is most dilute with respect to sucrose and has the largest percentage error. The second analysis is one performed on the same mixture by the authors of this paper, using the method of neutral polarization.

TABLE III.

Analyses of Sucrose-Invert Sugar Mixtures.

Analyst.	Invert Sugar. Grams. in 100 c.c.	P - P'	Temper- ature. Degrees C	Sucrose Found. Per cent.	Sucrose Taken. Per cent.	Error.
Browne	9.86 ..	26.48 ..	20.4 ..	19.82 ..	19.23 ..	+ 0.59
Jackson and Gillis, Method 2	9.95 ..	25.462 ..	20.28 ..	19.21 ..	19.23 ..	- 0.02

In view of the above facts, Dr. Browne's conclusion that "the methods of acid inversion can be regarded at their best as only a more or less satisfactory approximation" is disproven in its entirety. His decision that "the only method of double polarization which is free from the objections named is the invertase method" is likewise disproven. When we consider the eccentricities of invertase and the inherent difficulties in its application, we question whether Dr. Browne really intended to suggest its use in modern sugar-house work. In this connexion the question becomes pertinent whether the presence of inorganic material in sugar products of high ash content does not raise the same question, although perhaps in lesser degree, that he has presented in regard to acid inversion.

The present status of the Clerget analysis is then, that between 90 and 100 per cent. of the errors of the ordinary acid inversion method are eliminated in the modified method. If further improvement is to be effected, it will come primarily as a product of basic researches on (1) the effect on concentration on the specific rotation of sucrose; and (2) the effect of concentration on the specific rotation of invert sugar. Both of the researches are in progress at the Bureau of Standards. These fundamental researches will possibly reduce errors of the second order of magnitude if such exist.

Basing our opinion upon the analytical results given above, and in our previous communication, we conclude that the modified Clerget method is capable of indicating the sucrose content of a mixture with high order of accuracy.

Bureau of Standards,

Washington, D.C., U.S.A.

American Commerce Reports.¹

CONDITION OF THE GERMAN SUGAR INDUSTRY AT CLOSE OF 1920.

Germany is confronted with the problem of increasing its sugar production to meet domestic needs. In the year 1919-20 there was a total of 269 sugar beet factories in operation in Germany, as against 307 for 1918-19. Since the latter period 30 of the 307 factories referred to passed out of German jurisdiction along with those territories transferred from Germany under the treaty of Versailles.

The sugar beet production in Germany during the period 1919-20 only attained an average of 19 metric tons per hectare, the lowest average for many years. This diminished production is ascribed in part to the bad weather conditions existing at the time of planting and to the inadequate cultivation of the crops, due to the lack of labour, and to strikes. The first examination of the plants disclosed the fact that the average weight of the root was only 88 grms. as compared with the preceding year's weight of 173 grms., and a

¹ Cited from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

American Commerce Reports.

sugar content of 11·7 per cent., as against 12·4 per cent. for the preceding year. The final examination showed a somewhat increased average sugar content, but considerably smaller beets, namely, 342 grms. weight and 20·9 per cent. sugar content, as against 504 grms. and 19·8 per cent. respectively, for the year previous. Then a further setback to production occurred in the form of frost, which set in just at harvest time and as a result prolonged the work of completing the harvest with an accompanying heavy loss in sugar.

The net sugar production for 1919-20 amounted to a total, in round numbers, of 733,000 tons of raw sugar, as compared with 1,346,000 tons produced in the preceding year. Consequently, the domestic production was inadequate to meet the country's needs, which during the preceding year amounted to about 1,000,000 tons. It therefore became necessary for Germany to import 57,000 tons of sugar, as compared with the 29,000 tons imported during the preceding year. The only thing that saved Germany from a heavier importation during the 1919-20 period was the supply of 216,000 tons which became available from the stocks of the preceding year.

At the beginning of the new sugar year Germany finds itself without available stocks of this commodity on hand. There is felt more than ever the pressing need of developing the sugar beet cultivation and increasing production as far as possible. Conditions appear to be propitious for such a result. The cultivable acreage shows a slight increase—4 per cent.—over that of the preceding year, and the fields are reported to be in good condition. The question remains as to whether the sugar factories will receive supplies of coal adequate to their needs and whether strikes among the farm labourers will disturb cultivation. —[Department of Commerce Report, Jan., 1921]

SUGAR PRODUCTION IN MADEIRA, 1920.

The sugar cane crop in Madeira in 1920 amounted to about 39,000 metric tons, valued at approximately 1,872,000 escudos, as compared with 43,000 metric tons in 1919, valued at slightly more than 920,000 escudos. (The escudo, normally worth \$1·08, had an average value of \$0·52 during 1919, and is at present (December, 1920) worth about \$0·11. The small crop was due principally to the high cost and consequent lack of chemical fertilizers and to the utilization of cane lands for grain and vegetables. The 1921 crop is estimated to be about the same as that of 1920. The total quantity of sugar produced was 2,153 metric tons, as compared with 1,700 metric tons in 1919. Corresponding figures for exports of sugar were 400 and 313 metric tons, all of which went to continental Portugal. The production in 1918 was 2,527 metric tons, which, in turn, was only about 50 per cent. of normal.

More than 50 per cent. of the 1919 crop was turned into cane brandy. Of the 1920 crop, 10,000 metric tons produced 800,000 litres (1 litre = 0·264 gallon) of brandy and 2000 tons produced 324,411 litres of alcohol. As the crop was insufficient to satisfy the local demand for alcohol, molasses is now being imported from the United States for this purpose.—[Consular Report, Dec., 1920.]

PRODUCTION OF ALCOHOL IN DUTCH EAST INDIES.

The total amount of exports of alcohol from Dutch East Indies in 1919, given at 15,444,000 litres, and the corresponding figures for the first six months of 1920, given at 8,305,000 litres, show a marked advance over the total amount of 4,713,000 litres for the year 1918, and surpass the figures for 1914, when the exports were 12,209,000 litres. The figures indicate that the trade is rapidly assuming an important position and bids fair to exceed in the present year (1920) even the phenomenal figure of 17,542,000 litres for 1915, and 17,630,000 litres for 1916.

This advance has been caused chiefly by much larger shipments to Italy and France than before the war; by remarkable increases in the sales to east Asia (Singapore, Hong-kong, and China) and to Australia; and by an extraordinary advance during the latter part of 1919 and the first six months of 1920 in shipments to the Netherlands. These latter exports (1,630,000 litres during the first six months of 1920) indicate that at the end of the year 1920 the trade with the mother country in this product will surpass any previous figure.

During 1919 the price of alcohol per litre, f.o.b. Java ports, rose from 12½ cents to about 20 cents in the currency of the Dutch East Indies, or an approximate increase from 5 to 8 cents United States currency. This advance in price has, with but few exceptions, covered the higher expenses of manufacture caused by the increase in labour costs, transportation, and other expenses. A circumstance which greatly favoured local manufacturers was the fact that material costs in many cases did not show a proportionate increase, because of large contracts for raw material (liquid molasses) which were made before the advance in price.

BRITISH EAST AFRICA AND SUGAR.

The sixth place in the order of value of the imports into British East Africa and Uganda is occupied by sugar. There has been a steady increase in the demand and importation. The largest importation in quantity arrived in the year prior to the war, and though 1917-18 shows a small decrease in quantity as compared with that year, the increase in value from that time is over 50 per cent. The average declared value in 1913-14 was 2.9 cents per lb., as against 6.3 cents in 1918. Since 1912 Java has been the principal source of supply of sugar for British East Africa and during 1918 its share amounted to 69 per cent. of the total; 20 per cent. came from Mauritius. Owing to the increased demand it is being strongly recommended that sugar should be produced in the country, many parts of which are ideal for the growing of cane.—[Commerce Reports.]

BRAZILIAN SUGAR CROP FOR 1920-21.

The Federal Food Commission (Delegacao do Abastecimento Publico) has estimated that the Brazilian sugar production for 1920-21 will amount to 8,768,600 bags, originating in the various States of Brazil as follows:—

	BAGS.		BAGS.
Para	13,300	Sergipe.	300,000
Maranhao.	19,000	Bahia	550,000
Ceara	208,300	Rio de Janeiro	1,300,000
Rio Grande do Norte .	153,000	Sao Paulo	600,000
Parahyba	160,000	Minas Geraes	1,650,000
Pernambuco.	2,800,000	Matto Grosso	25,000
Alagoas	1,000,000		
		Total	8,768,600

[Consular Report, November, 1920.]

Correspondence.

THE PURITY OF THE FINAL MOLASSES IN HAWAII.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

SIR,—In the report on Sugar Manufacture and By-product Utilization in Hawaii, published in your *Journal*,¹ we find a statement to the effect that in the year, 1919, the average gravity purity of the exhausted molasses in that country was 38.07°. A calculation is made of the profit that might have been reached, if the quotient had been forced down to a lower degree. The means of attaining such an end are sought in "more pans and more crystallizers"; while great importance is attached to the type and the dimensions of the crystallizers.

This is what I have always had in my own mind. It would appear that the WILLIAMS process,² which promised to reduce the purity of the exhausted molasses to a much lower level, has not had the success predicted by its inventor and his supporters. If such had been the case, the average purity of the molasses in those islands might have been lower than 38 points.

H. C. PRINSEN GREELIGS, Ph.D.

¹ *I.S.J.*, 1921, 155.

² See *I.S.J.*, 1917, 90, 159, 297, 404 and 568; 1918, 86, 87, 328.

Publications Received.

Reports of the Progress of Applied Chemistry. Vol. V. (Society of Chemical Industry, Central House, London, E.C.2). Price: 8s. 3d. (post free) to members of the Society; and 15s. (post free) to non-members.

Volume V (i.e., dealing with 1920) of the Annual Reports of the Society of Chemical Industry is now published. As we have pointed out on previous occasions,¹ these reports are intended to summarize critically the very large amount of work done during the year in the various branches of chemical industry, the purpose of each contributor being to write in such a manner as to allot to each development its proper place in the chronicle of progress. Their publication continues to meet with considerable success, showing that they supply a want generally felt among chemists. One of their principal advantages that will be realized by all is that they enable those specializing in a particular branch to follow the trend of other directions of activity.

In the present volume the section on Sugar has been prepared by Mr. J. P. OGILVIE, who deals with matters such as the colloidal nature of the clarification of cane juice, and the developments that may be expected in this direction; the question of the loss of sugar which may occur during evaporation by entrainment; factors controlling crystallization; recently proposed methods of boiling, centrifuging and finishing in the cane sugar factory; the "rapid" trough method of beet juice extraction developed during the war in certain German factories; beet juice clarification from the stand-point of colloidal chemistry; etc. Further, the sugar technologist will find matters of interest in other sections, such as those on general plant by Dr. W. B. DAVIDSON (boilers, centrifugal machines, and filters); Agricultural Chemistry by Dr. E. J. RUSSELL, F.R.S., (fertilizer problems; stimulants to plant growth, and soil acidity in relation to the condition of soils); and also on Fermentation Industries by Messrs. A. TAIT and L. FLETCHER, (yeast, saccharification of starch, power alcohol, etc.).

An Introduction to the Chemistry of Plant Products. By Paul Haas and T. G. Hill. Vol. I (Nature of the Commoner Organic Compounds of Plants). Third edition. (Longmans, Green & Co., London and New York.) 1921. Price: 16s. net.

A third edition of Haas and Hill's excellent work has just been published; and, considering the valuable nature of its contents, there need be no surprise at the demand for another issue so soon after the appearance of the preceding one.² It has been decided to enlarge the scope of the work, which change has necessitated its printing in two volumes. Volume I is essentially the same in scope as were the earlier editions,³ and deals primarily with the more purely chemical aspect of the subject; while volume II (which is now in preparation) will be devoted mainly to physiological problems. This present volume has been brought up to date, and a certain amount of rearrangement has been made; but essentially the book remains as before, that is, a compilation of very useful information relating to plant chemistry that is certainly of interest to every chemist. It reviews our present state of knowledge relating to carbohydrates; pigments; tannins; proteins; enzymes; glucosides; and fats, oils and waxes; and there is also a section dealing with the colloidal state. We draw the attention of sugar chemists to this work as a valuable reference book. It forms a useful source of information bearing upon the problems involved in plant metabolism, and contains many facts which previously were only to be found rather widely scattered throughout the literature of the subject.

¹ *I.S.J.*, 1920, 342; 1919, 34, 296; 1917, 374.

² *I.S.J.*, 1919, 347.

³ *I.S.J.*, 1913, 579.

The Analyst's Laboratory Companion. By Alfred E. Johnson, B.Sc., F.I.C. Fifth Edition. (J. & A. Churchill, London.) 176 pages, 1920. Price: 10s. 6d. net.

In this fifth edition of Johnson's "Laboratory Companion," to the useful character of which the attention of our readers was directed at the time of the publication of the previous issue,¹ several important additions have been incorporated. For example, in the section on sugars the data relating to their specific rotatory power and cupric reducing power now includes Brown, Morris, and Millar's tables for gravimetric determinations, and Brown and Jones's solution factors; while further a detailed description is now given of Ling and Rendle's volumetric method of determining reducing sugars.² Elsewhere in the book it will be found that Sir Edward Thorpe's alcoholometric tables³ are given in a condensed form, and that the new official table for the determination of the original gravity of beer replaces the old tables of GRAHAM, HOFMANN, and REDWOOD. Other revisions relating chiefly to physical data have also been made. As we pointed out before, Johnson's "Companion" forms a really valuable *vade-mecum* for the use of the general analyst and works' chemist, giving as it does a large amount of practical analytical information in a conveniently arranged form. In regard to the section on sugars, it may be remarked that on the whole it is well written, though the information given would appear to have been selected chiefly for the purpose of the brewery chemist. Some few further additions to this part of the book therefore seem desirable, in order to make it more serviceable to the general analyst who may from time to time have occasion to turn to the commercial analysis of raw sugars and molasses.

Modern Manufacture of Chemical Manures (Superphosphate Fertilizers).

(Sturtevant Engineering Co., Ltd., London.) 1920. Price: 12s. 6d.

Since the inception of the superphosphate industry early in the nineteenth century, there has been a gradual development in the efficiency of the various stages of manufacture, and the improvements that have been effected have been mainly in the direction of devising mechanical means for a more rapid output, while a matter that has always been kept in view has been the production of a uniform grade capable of being easily distributed over the land. Although in this book only the equipment supplied by the Sturtevant Engineering Company is described and illustrated, it nevertheless forms a very useful contribution to the literature of the subject, one that should be in the hands of every chemical engineer concerned with this important branch of industry who desires to be well informed in regard to recent progress. Each stage in superphosphate manufacture, e.g., crushing, grinding and screening of raw material; mixing, bagging, and weighing is described in detail, while an account is also given of important accessory apparatus, as dust collectors, acid and phosphate scales, fume exhausters, and lastly conveying and elevating machinery.

Sugar Beet Growing under Humid Conditions. C. O. Townsend. Farmers' Bulletin, 568, U.S. Department of Agriculture. (Superintendent of Documents, Washington, D.C., U.S.A.) Price: 5 cents.

Contents:—Soil; climatic conditions; ploughing; fitting seed and root beds; drainage; holding the moisture; planting; spacing and thinning; hoeing; cultivating; rotation; fertilizers; harvesting; and by-products.

Sugar Beet Seed Growing in the Rocky Mountain States. W. W. Tracy, Jr. Farmers' Bulletin, 1152, U.S. Department of Agriculture. (Superintendent of Documents, Washington, D.C., U.S.A.) Price: 5 cents.

Contents:—Growing beet seed an established industry; size of roots for seed; time to sow seed; spacing for stocklings; care of stockling crops; time to harvest stocklings; transplanting; cultivating seed crops; harvesting seed crops; and cleaning seed crops.

¹ I.S.J., 1912, 534.

² I.S.J., 1908, 357.

³ I.S.J., 1915, 427.

Review of Current Technical Literature.¹

RECENT EXPERIENCES WITH (a) THE DORR THICKENER FOR DEFECCATED JUICES, AND (b) THE WILLIAMSON CLARIFIER FOR SYRUPS. *W. D. Horne. Journal of Industrial and Engineering Chemistry, 1920, 12, No. 12, 1179-1180.*

DR. HORNE gives some interesting information in regard to these two developments in juice and syrup clarification, this being supplementary to his previous contribution on this subject.² (a) An initial run was made in the spring of last year with the Dorr thickener at the Central Mercedita, Province of Pinar del Rio, Cuba. A single unit consisting mainly of a cylindrical apparatus 18 ft. in diameter by 10 ft. high, containing two trays (or transverse diaphragms), and equipped with slowly revolving scraper mechanisms, was found capable of treating all the juice from the 1600 tons of cane ground daily. After liming as usual, the juice was raised in the Deming heater nearly to boiling point, and fed to the central loading-well of the Dorr apparatus. Sedimentation was very satisfactory and the clarified liquid flowing out of the peripheral pipes was much clearer than that previously obtained from open defecators, while mud twice as concentrated as ordinarily, carrying only about 5 per cent. of juice, was obtained. It was diluted, and passed directly to the filter-presses with little or no further liming or heating. After the installation of the apparatus, it was found that the insoluble matter in the sugar fell to 63 mgrms per 100 grms., whereas under the usual system it had been 87. Further, the sucrose left in the press-cake was decreased from 6.75 to 5.5 per cent. and the consumption of coal dropped from 16.2 tons to 8.8 tons, due to the fact that the juice entering the well-lagged tank at 207°F. (97°C.) left at 202°F. (94°C.), the economy claimed being thus nearly 8 tons per day. (b) In regard to the Williamson clarifier,⁴ in one of the runs made in a refinery in America, 6375 gallons of liquor at 63° Brix obtained from washed raw sugar were treated in 6.75 hours, that is, at the rate of 945 gallons per hour, with the production of 352 gallons of scum (or 3.65 per cent. of the original solids), which scum was twice washed by decantation, leaving 298 gallons (or 1.05 per cent. original solids) to be filter-pressed. The press-cake obtained occupied a volume equal to 31 gallons, and weighed 157 lbs.; while the purity of the press-water was 93.3, as compared with 94.3° for the first dilution. The amount of sweet-water produced was 18.2 gallons for 100 gallons of original liquor, a considerable proportion of which could be utilized in preparing succeeding washed sugar liquor. During the treatment, the invert sugar in the liquor rose from 0.69 to 0.83 per cent.

EXPERIMENTS ON THE ESTABLISHMENT OF THE CONSTANT FOR THE CALCULATION OF THE SUCROSE PER CENT. IN THE HERZFELD MODIFICATION OF THE DOUBLE POLARIZATION METHOD. *Otto Schrefeld. Zeitschrift des Vereins der deutschen Zucker-Industrie, 1920, No. 776, 402-408.*

Experiments which were carried out in 1910 by the late Prof. O. SCHREFELD (of the Vereinslaboratorium) on the establishment of the constant in the Herzfeld modification of the double polarization method are here published, prefaced by an explanatory note by Prof. HERZFELD. This work is of interest in showing that SCHREFELD had at that time anticipated certain of the conclusions of JACKSON and GILLIS⁵ relating to the inaccuracy of the Herzfeld constant of 132.66. Thus, 13 grms. of sucrose dissolved in 75 c.c. of water in a 100 c.c. flask were hydrolysed in the presence of 5 c.c. of concentrated hydrochloric acid (sp. gr., 1.19) at different temperatures, the following values being read:—

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

² *I.S.J.*, 1920, 584, 650.

³ *I.S.J.*, 1921, 93.

⁴ *I.S.J.*, 1919, 525; 1920, 114; 650.

⁵ *I.S.J.*, 1920, 175, 509, 570, 638.

TEMPERATURE OF INVERSION, °C.	DURATION OF INVERSION, MIN.	POLARIZATION AT 20°C.
70	5	— 16.48
67	5	— 16.45
60	5	— 16.35
60	10	— 16.45
60	15	— 16.45
50	5	— 9.75

Thus, at 60°C. (the degree recommended by JACKSON and GILLIS) the constant 132.9 was found; while at room temperature after 48 hours, one of 133.1 was obtained. It was concluded by SCHREFFELD that the constant for this concentration should be in the neighbourhood of 133. In regard to other concentrations, it was found that the constant is a linear function increasing from 132.0 for 4 to 133.0 for 13 grms. of sucrose in 100 c.c. In explanation of Herzfeld's factor of 132.66, it was suggested that this lower value might possibly be accounted for in part by the use of refined sugar containing some raffinose, since at that time the presence of the trisaccharide was prevalent in raw sugars.

RAPID ESTIMATION OF THE AMOUNT OF INVERT SUGAR PRESENT IN A PARTIALLY HYDROLYSED SYRUP. *W. Paar. Zeitschrift des Vereins der deutschen Zucker-Industrie, 1920, No. 776, 409-413.*

German beet sugar manufacturers making table syrup have expressed the desirability of possessing a rapid method of approximately estimating the amount of invert sugar present in their partially hydrolysed products. Given the quotient of purity (Q) of the syrup before commencing inversion; the Brix (B), after inversion and concentration; and the polarization (P), also after inversion and concentration, the per cent. of invert sugar (I) can be ascertained in the following manner:— S (the uninverted sucrose) = $\frac{B \times Q}{100} - I$; $P = \frac{B \times Q}{100} - 1.3266$; $P = \frac{B \times Q - 100P}{132.66}$; $I = 0.00754 (B \times Q - 100P)$. Thus, for example, if the values found are: Q , 90; B , 80; P , 27.3; then $I = 0.00754 (90 \times 80 - 27.3 \times 100) = 33.70$ per cent. of invert sugar; while the total sugar = $\frac{B \times Q}{100} = 72.0$ per cent. In place of the value of I stated above, one may write:

$I = 0.754 \left(\frac{B \times Q}{100} - P \right)$, from which values one may deduce the facts that if the polarization is equal to the total sugar content, the invert sugar is 0; and that for every degree of difference between the total sugars and the polarization, the invert sugar (calculated as sucrose) is increased by 0.754. Thus, in the above example: $72.0 - 33.70 = 44.7$; and $44.7 \times 0.754 = 33.70$ per cent. of invert sugar. Having these values, it is possible to construct a table for the ready observation of the invert sugar per cent. (calculated as sucrose), and the following one holds good for syrups having a quotient of purity of 90° before inversion:—

TABLE I.
Invert Sugar, per cent.
(Purity of Syrup, 90°.)

	Brix = 80° Total Sugars = 72	Brix = 75° Total Sugars = 67.5	Brix = 70° Total Sugars = 63	Brix = 65° Total Sugars = 58.5	Brix = 60° Total Sugars = 54	Brix = 55° Total Sugars = 49.5	Brix = 50° Total Sugars* = 45
Polarization.							
70 ..	1.51 ..	— ..	— ..	— ..	— ..	— ..	— ..
60 ..	9.05 ..	5.66 ..	2.26 ..	— ..	— ..	— ..	— ..
50 ..	16.59 ..	13.20 ..	9.80 ..	6.41 ..	3.02 ..	— ..	— ..
40 ..	24.03 ..	20.74 ..	17.34 ..	13.95 ..	10.56 ..	7.17 ..	3.77 ..
30 ..	31.67 ..	28.28 ..	24.88 ..	21.49 ..	18.10 ..	14.71 ..	11.31 ..
20 ..	39.21 ..	35.82 ..	32.42 ..	29.03 ..	25.64 ..	22.25 ..	18.85 ..
10 ..	46.75 ..	43.36 ..	39.96 ..	36.57 ..	33.18 ..	29.79 ..	26.39 ..
0 ..	54.29 ..	50.90 ..	47.50 ..	44.11 ..	40.72 ..	37.33 ..	33.93 ..
—10 ..	61.83 ..	58.44 ..	55.04 ..	51.65 ..	48.26 ..	44.87 ..	41.47 ..
—20 ..	69.37 ..	65.98 ..	62.58 ..	— ..	— ..	— ..	— ..

Review of Current Technical Literature.

TABLE II.

Polarization Units.

(Subtract when plus reading ;
and add when minus.)

1	0.75
2	1.51
3	2.26
4	3.02
5	3.77
6	4.53
7	5.28
8	6.04
9	6.79

TABLE III.

Brix Units.

(Values obtained to be always added.)

1	0.68
2	1.36
3	2.04
4	2.72
5	3.40
6	4.07
7	4.75
8	5.43
9	6.11

These last two tables show the units (and decimals) of polarization and Brix respectively, and the following example illustrates the use of all three tables: Q is 90; B , 76; and P , 23; for a Brix of 70 and a polarization of 20, 32.42 is read from the first table: corresponding to 3 in the polarization table is 2.26, and $32.42 - 2.26 = 30.16$; while for the Brix of 76, the value is $30.16 - 4.07 = 26.09$ per cent. of invert sugar (calculated as sucrose). Table I of course holds good only when the purity of the syrup was originally 90°, and in the case of other purity quotients the values are quite different, so that special tables must then be calculated.

COST OF PRODUCTION OF WHITES IN THE FACTORY BY RE-MELTING RAWS APPLYING THE PHOSPHATATION, CARBONATATION, AND SULPHITATION PROCESSES, AND USE OF KIESSELGUHR AND DECOLORIZING CARBONS, FOR CLARIFICATION. *C. E. Coates. Journal of Industrial and Engineering Chemistry*, 1921, 13, No. 2, 147-153.

Sporadic attempts have been made in Louisiana to buy raw sugars in the tropics, and "refine" it during the inter-season, in order thus to take advantage of the idle equipment; but in the case at any rate of one house making this venture some few years ago results do not appear to have been successful, owing presumably to the small margin existing between 96° test and white granulated. It is difficult at the present time to state this margin; but when 96° test was selling for 4 cents it was estimated that the limit was 80 cents per 100 lbs., anything above this figure showing a profit. Re-melting raw sugar and turning out white granulated is not in the least a simple operation, though superficially it appears so; and even when the margin is high, it is rarely large enough to stand much loss in process, as the following figures indicate: 100 lbs. of 96° test sugar, sold in bags and delivered at 18 cents per lb., will yield in good refinery practice 93 lbs. of white granulated and 7 lbs. of molasses with practically 1 per cent. loss in process. Selling this 93 lbs. at 20 cents gives \$18.60, and adding 20 cents for the molasses gives \$18.80, or 80 cents gross profit. Raw sugar bags cost about 12 cents per 100 lbs. of sugar, and the granulated is sold in barrels costing about 40 cents per 100 lbs., the net loss on cooperage being 25 cents per 100 lbs., which, subtracted from 80 cents, leaves 55 cents to cover both cost of manufacture and profit. If, on the other hand, the raw sugar costs only 4 cents, and the granulated sells at 5 cents, the yield from the 93 lbs. will be \$4.65 and adding 10 cents for the molasses, and subtracting 20 cents for the cooperage (less rebate on the bags), leaves 55 cents for gross profit, including both cost of the manufacture and the profit. Assuming the cost of the process for the 4 cent sugar to be 36 cents, this gives about 20 cents per 100 lbs. as the margin of net profit. In the case of the 18 cent raw sugar, the cost of the process would be about 70, which therefore shows a loss of 15 cents, even though the margin in one case is 100 points and in the other 200. Furthermore, if with the 4 cent raw sugar, the yield is 91 lbs. instead of 93, the profits are reduced by 10 cents; while with the 18 cent raw sugar a yield of 91 lbs. adds 40 cents to the deficit. It would indeed hardly pay to re-melt 18 cent sugar on a plantation at a margin less than 100 points, as can be seen from the following example: A very good yield is 90 lbs. and

about 8 lbs. of molasses, so that 90×21 is \$18.90 and with the value of the molasses \$19.10, making a gross profit of \$1.10. Calling the cost of manufacture 70 cents, and cooperage 25 cents, this leaves 15 cents net profit, which is little enough indeed. So it is seen that a margin which pays with 4 cent sugar may mean bankruptcy with 18 cent sugar. "It is well to impress this point on the planter, because otherwise when he sees the refiner getting 2 cents margin, he may over estimate the refiner's profit, and try it himself with somewhat disastrous results."

Following this, Dr. COATES discussed various points connected with the process of re-melting, clarifying, and re-boiling of raws for the production of white granulated without the use of animal charcoal, the more important of which may be briefly mentioned here. In clarifying by phosphatation (the commonest method of defecation in this practice), the 55° Brix liquor obtained from the re-melted sugar is heated to 195-200° F. (91-93° C.), and phosphoric acid at the rate of 0.25 lb. P_2O_5 per 1000 lbs. of sugar added, the acidity then being about 0.6 c.c. of N/10 for 10 c.c. of liquor, using phenolphthalein. Immediately after, 0.25 lb. of lime (CaO) per 1000 lbs. of sugar follows, the acidity then becoming 0.35 c.c., that is almost neutrality to litmus. After blowing up for a few minutes, the defecated liquor goes to the bag filters, and it has been found that the Greenwood type with moveable head gives considerably better satisfaction than the old-style Taylor. It is regarded as good practice to sulphur the filtrate to about 8 c.c. before sending it to the pans for granulation, it being thought that better sugar and molasses are obtained. Several years ago a quantity of raw sugar was refined by a carbonatation process by re-melting to 28° Bx. (50-5° Brix), cooling, to 35° C. (95° F.), adding 2 per cent. of lime as $Ca(OH)_2$ on the weight of sugar, carbonatating cold to neutrality to phenolphthalein, heating to 93° C. (200° F.), re-carbonatating, and lastly filtered. It was claimed that this process was about 10 cents per 100 lbs. cheaper than bone-black refining, and that it gave nearly 1 lb. more sugar; but although the sugar produced proved to be of fairly good quality the cost proved unsatisfactory, and working was abandoned after a few months. Sulphitation has given excellent results in some hands, but has proved less satisfactory in others, and it is advised that the calcium sulphite be formed at about 70° C. (158° F.), sulphur dioxide, and milk-of-lime being added simultaneously, the final acidity attained being the same as in the case of phosphoric acid given above. Kieseluhr is said to give very satisfactory results, especially if the procedure is as follows: The washed raw sugar is conveyed from the centrifugals to mixers, where it is treated with 12-16 lbs. of kieseluhr per ton of raw product in the form of an aqueous slurry of about 12° Bx. (21-3° Brix), and brought into intimate contact with the molasses film remaining, following which it is re-melted, and bag or filter pressed, preferably applying a pre-coat of kieseluhr. Kieseluhr may be revived by burning at a low temperature, leaving a little carbon to act as a further filter-aid, and the cost of this is estimated to be about \$5 per ton. It was found possible to regenerate five times in this way without any apparent difference in the filtering effect. Decolorizing carbons are also discussed by Dr. COATES; and in regard to these it is said that while the quality of the product obtained is beyond criticism, and fully equal in every respect to standard granulated, "the cost of operation seems to be higher than that of a bone-black plant," though the author sees no reason why the process cannot be made fully the equal of char in both cost and yield, as soon as the usual chemical and mechanical difficulties have been overcome.

YIELD AND COST IN REFINING RAW SUGAR IN LOUISIANA. C. E. Coates. *Journal of Industrial and Engineering Chemistry*, 1921, 13, No. 2, 147-148.

Some years ago in Louisiana, a considerable amount of raw sugar was refined (in bone-black sugar-houses). Thus a certain company when sugar sold at 4.5 cents received 100 lbs. of 96° test raw in bags and delivered 93 lbs. of granulated in barrels, charging 60 cents toll per 100 lb. of raw, and keeping the molasses, which at that time was worth about 5 cents. Possibly the cost of the molasses covered the loss on cooperage (after selling the bags) leaving 60 cents as the net profit, which was considered a satisfactory charge at that time. If at the present day, sugar were refined on toll, it would be necessary to double the

Review of Current Technical Literature.

previous toll and add 25 cents to cover the difference on cooperage, the total rate depending upon the cost of the raws. It is of interest to note that when sugar was refined on the toll system, the delivery of the granulated per 100 lbs. of raw was based on polarization, according to the following table, representing perfect refinery practice over a number of years, the granulated per cent. of total solids in raws being calculated from the following

formula: $\frac{\text{Purity of raws} - \text{purity of molasses}}{\text{Purity of granulated} - \text{purity of molasses}}$ in using which 96° test sugar is assumed to carry 1 per cent. of moisture and to be of 97° purity, the molasses of 40° purity, and the granulated of 100°. One lb. of sugar being allowed as a reasonable loss, one obtains on substituting these figures $\frac{97 - 40}{100 - 40} = 0.95$ on 100 lbs.; and 0.95×99 is 94, and 94

less 1 lb. loss in process leaves 93 lbs. of granulated sugar recovered per 100 lbs. of 96° test re-melted, together with 6 lbs. of molasses of 40° purity and 1 lb. of sucrose lost in process.

POLARIZATION RAW SUGAR, DEGREES.	GRANULATED, LBS.	POLARIZATION RAW SUGAR, DEGREES.	GRANULATED, LBS.
98.0	95.0	94.5	90.4
97.5	94.5	94.0	89.5
97.0	94.0	93.5	88.2
96.5	93.5	93.0	87.7
96.0	93.0 (standard)	92.5	86.9
95.5	92.1	92.0	86.0
95.0	91.25		

That this table though empirical is not far wrong may be seen from the following figures obtained recently by a very well equipped bone-black refinery: Polarization, 95.7; yield of granulated, 92.46 lbs.; molasses, 7.37 lbs.; and loss of sucrose in process, 0.804 lb.; while the above table would give 92.46 lb. It may be added that 3.5 to 4 gall. of oil were burned per 100 lbs. of raw sugar re-melted. Of course it is very well known that raw sugars may have the same polarization and yet give different yields, a soft small-grained sugar with gummy molasses and high ash content giving considerably less granulated than a hard large-grained sugar carrying normal molasses of low ash content.

STUDY OF THE LOSS OF SUGAR CAUSED BY DELAY IN HARVESTING BURNT CANE.

J. A. Verret. Report made to the Hawaiian Sugar Planters' Association, 1920.

In order to determine the loss taking place when handling cane from large accidental or incendiary fires, especially when harvesting is delayed, a level uniform section of about 3 acres (under irrigation) was selected on Ewa plantation. This area consisted of four water courses (each containing 144 full lines and a few hapas), the cane (H. 109) in the first being unburnt to serve as the control; and that in the third and fourth being burnt standing; while the second course was used as a fire-break. There were 48 plots, divided into four series of 12 each, which were harvested (a) immediately after burning, (b) 5, (c) 10, and (d) 15 days after burning; and whenever burnt cane was harvested, a corresponding area of unburnt plant from the first course was likewise collected. Interesting results were obtained, and these have been analysed by Dr. NORRIS and Mr. BOMONT, a summary of their conclusions being as follows; (1) Burnt cane lost 50.23 per cent. of its original sugar when harvesting was delayed 15 days after burning, that is 3.35 per cent. per day. During the first 5 days the total loss was 14.72 per cent., or 2.94 per cent. per day; in 10 days it was 29.74 per cent., or 2.97 per cent. per day. The rate of deterioration shows a gradual increase as the time since burning increased. (2) There is very little difference in the loss between burnt cane cut at once and burnt cane allowed to stand until milled. (3) When burnt cane was allowed to stand, the loss in weight of the cane at the end of 5 days amounted to 6.57 per cent., or 1.32 per cent. per day. In 10 days the loss was 11.39 per cent., or 1.14 per cent. per day; and in 15 days it was 20.29 per cent., or 1.35 per cent. per day. (4) When burnt cane was cut immediately after the fire, the loss in weight of cane was 16.30 per cent. in 5 days, or 3.06 per cent. per day. In 10 days the loss was 22.45 per cent., or 2.25 per cent. per day; and in 15 days it was 19.18

per cent., or 1.95 per cent. per day. As was to be expected, the rate of loss in the cut burnt cane tends to diminish as the cane becomes drier. (5) When burnt cane is allowed to stand, the density of the juice does not increase, there being, on the other hand, a slight tendency towards a decrease. (6) When, however, the cane is cut, there is a decided increase in the density of the juice, the figures observed being 18.6° on the first and 22.1° on the 15th day. (7) Whether cut or standing, the purity of the juice drops in purity at about the same rate. (8) The figure for the tons of cane per ton of sugar (quality ratio) of cut burnt cane is better than that of standing burnt cane, this being due entirely to the higher density of the juice from the cut cane.

"KELPCHAR," A NEW DECOLORIZING CARBON. *J. W. Turrentine, P. S. Shoaff, and G. C. Spencer. Science, 1919, 50, No. 1300, 507.*

Following the researches of Dr. ZERBAN,¹ it was shown that a decolorizing carbon of high activity could be produced in large quantity, the method of heating being of importance. One-stage retorting was efficacious under certain conditions, but did not yield a product of uniform grade. Two-stage retorting, on the other hand, gave satisfactory results, and it was decided to follow this method pending the optimum conditions obtaining in the first named operation. After leaving the retorts, the porous charcoal remaining was heated with hot water to remove the potassium chloride and iodide, the residue heated with dilute hydrochloric acid, washed with water to neutrality, and lastly dried and packed. It is said the product compares favourably with "Norit," and offers every promise ultimately of meeting the requirements of the chemical industry for a carbon of the highest grade.

VOLUMETRIC DETERMINATION OF REDUCING SUGARS, USING STANDARD THIOCYANATE SOLUTION. *G. Bruhns. Zeitschrift für anal. Chemie, 1920, 59, 337-359.*

Twenty c.c. of Fehling's solution and 20 c.c. of the sugar solution are boiled for exactly 2 mins., and rapidly cooled; 5 c.c. of a solution containing 0.65 gm. of potassium thiocyanate and 0.1 gm. of potassium iodide are added, followed by 10 c.c. of 6.6 N sulphuric acid, and this mixture immediately titrated with thiosulphate solution (34.4 grms. per litre). A control titration is made at the same time, using the same quantities of reagents, but omitting the heating, the difference between the quantities of thiosulphate solution required for the two titrations being a measure of the sugar present. Tables to facilitate the calculation of the result are given.

VOLUMETRIC METHOD OF DETERMINING SEVERAL SUGARS (SUCROSE, DEXTROSE, LIEVULOSE, MALTONE, AND LACTOSE) IN THE PRESENCE OF EACH OTHER. *Th. von Fellenberg. Mitt. Lebensm. Hyg., 1920, 11, 129-153; through Journal of the Chemical Society, 1921, Abs. ii, 136.*

A method applicable to the estimation of sucrose, invert sugar, dextrose, maltose, and lactose, when three are present in the same solution, is proposed. It is based on the action of a weak and a strong inversion and a decomposition with sodium hydroxide of the various sugars present, with subsequent reduction of a copper solution, followed by an iodometric titration of the cuprous oxide formed. Examples of its application to commercial glucose and confectionery are given.

TABLES SHOWING ALCOHOL STRENGTH AND SPECIFIC GRAVITY. *G. Tommasi. Ann. R. Staz. Chim. Agrar. Sperim., 1917-1919, II, 9, 37-74; Journal of the Chemical Society, 1921, Abs. ii, 136.*

Tables are given showing the percentages of ethyl alcohol by weight and by volume (at $15^{\circ}\text{C}.$), and the number of grms. of alcohol in 100 c.c. at $15^{\circ}\text{C}.$ for the specific gravities of aqueous alcoholic solutions determined at a number of different temperatures ranging from $10/15$ to $25/15^{\circ}$.

J. P. O.

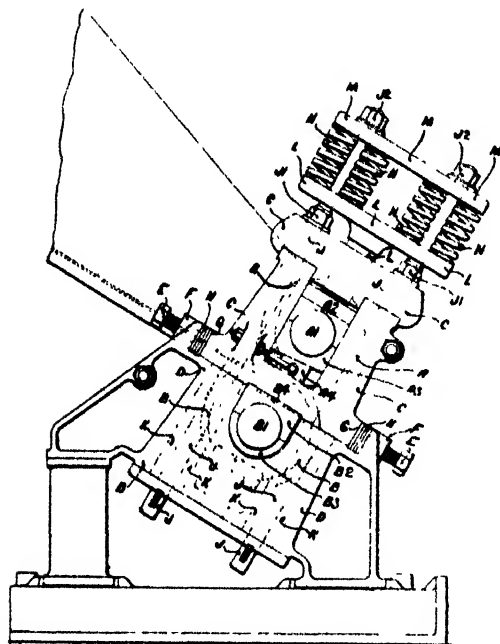
¹ I.S.J., 1919, 86.

Review of Recent Patents.¹

UNITED STATES.

MILL PROVIDING MEANS FOR ADJUSTING THE POSITION OF THE UPPER TO THE LOWER ROLL. *Charles McNeil*, of Govan, Glasgow, N.B. 1,365,521. May 5th, 1920; January 11th, 1921. (One figure).

The invention relates more particularly to mills having two rollers, one superposed upon the other, but is also applicable under some conditions to those having more than two rollers; and has for its object to provide ready means for adjusting the position of the upper roll to the lower roll in a plane substantially normal to that in which lie the axes of the rolls. As applied to the upper roll of a 2-roll mill, the housings of the upper roll are made separate from and are carried upon the upper parts of the housing of the lower roll.



The abutting parts of the upper and lower housings are in the form of co-acting guide surfaces in a plane substantially normal to the plane in which lie the axes of the rolls, and means are provided for adjusting the upper housings laterally upon the lower housings. For example, set pins bearing upon the ends of the bottom faces of the lower housing and mounted in lugs upstanding from the ends of the upper housing may be used in conjunction with packing pieces inserted between the lugs and faces. The bearings of the upper housing are held down by king bolts of usual type which also serve to hold the upper and lower housings in position. In order to accommodate the lateral adjustment of the upper housing, clearances are provided in the lower housing to permit of the movement of the king bolts. Pressure may be applied to the upper roll in any convenient manner.

An illustrative example is shown in the drawing. There are provided an upper roll *A* mounted on a shaft *A*¹ carried in bearing blocks *A*², *A*³, and a lower roll *B* mounted on a shaft *B*¹ carried in bearing blocks *B*², *B*³, the blocks being located in housings *C* and *D* respectively. The upper and lower housings abut each other in a plane substantially normal to that containing the axes of the rolls, the upper housing *C* being capable of adjustment in this plane across the face of the lower housing *D* and in a direction at right angles to the axes of the rolls. This adjustment is effected by means of set screws *E*, carried in lugs *F* on opposite sides of the lower housing *D*, and bearing on packing pieces *H* inserted between the inner faces of the lugs *F* and adjacent faces *G* formed on the lower part of the upper housing. The packing pieces *H* are in the nature of comparatively thin strips of metal extending across the whole length of the housings. The pressure of the screws *E* is exerted across a plane parallel to the plane of abutment of the housings. In order to

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 57, rue Vieille du Temple, Paris (price, 2fr. 00 each).

guide the upper housing while under adjustment and to prevent axial movement thereof, the upper bearing block B^2 of the lower roll B is provided at both ends with an upstanding ledge B^4 which abuts, and acts as a guide surface for the adjacent end face of the upper housing. The upper housing C is held hard down on the lower housing D by king bolts J and nuts J^1 , the latter being slackened when it is desired to adjust the lateral position of the upper housing by the set screws E . To allow for this lateral adjustment, clearances K are provided in the lower housing D , which permit of the necessary movement of the king bolts J . The king bolts project beyond the nuts J^1 through apertures in a press head L and yoke M , and are there secured by nuts J^2 abutting the upper surface of the latter. The press head L bears upon the upper surface of the bearing block A^2 . Pressure is applied to the upper roll by means of springs N arranged in compression around each king bolt J and between the inner faces of the press head and yoke. The lower bearing block A^3 of the upper roll is positioned by a wedge A^4 in the usual manner.

BERT HARVESTERS. (1) *Ronald Moreschini*, of Pueblo, Colo., U.S.A. 1,366,477. February 18th, 1918; January 25th, 1921. (2) *Olof Frankman*, of Malmö, Sweden. 1,366,645. October 25th, 1919. January 25th, 1921. (3) *Joseph E. Wyckoff*, of Los Angeles, Cal., U.S.A. 1,366,997. October 29th, 1919; February 1st, 1921.

BRET TOPPING AND EXCAVATING MACHINE. *H. Beckwith*. 1,367,853. February 8th, 1921.

MODIFICATION OF STARCH. *Ellery H. Harvey*, of Lansdale, Pa. (assignor to *Perkins Glue Co.*, of Pennsylvania, U.S.A. 1,366,653. May 13th, 1920; January 25th, 1921.

An electric current is passed through an electrically conducting bath containing the starch to modify or convert it, whereby it will dissolve in caustic soda solutions to produce less viscous solutions, the action being stopped before the soluble starch stage is reached.

CANDY CUTTING MACHINE. *George K. Bainbridge*. 1,368,685. February 15th, 1921.

CONFECTION CONE-CARRIER. *John J. Botnen*, of Abercrombie, N.B. 1,367,174. March 16th, 1920; February 1st, 1921.

MANUFACTURE OF MILK-SUGAR (LACTOSE), USING DECOLORIZING CARBON *R.W. Mumford*, (assignor to *Refining Products Co.*, of Wilmington, Del., U.S.A.). 1,366,822. July 2nd, 1917; January 25th, 1921.

In the manufacture of lactose from clarified and purified whey by evaporation to crystallization, claim is made for the process which comprises mixing the solution with an open textured granular vegetable carbon having open pores representing approximately the cellular structure of the original vegetable material at one or more stages in the operation, and separating the carbon.

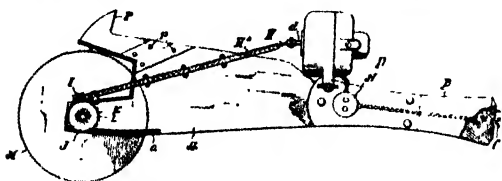
FOOD PRODUCT COMPRISING BAKED WHEAT FLOUR AND A CHOCOLATE COATING. *Lorraine J. Schumaker*, of Philadelphia, Pa., U.S.A. (assignor to *American Pretzel Co.*, of Philadelphia, Pa.) 1,366,961. December 2nd, 1919; February 1st, 1921.

FILTERS (1) *Peter C. Forrester*. 1,349,056. August 10th, 1920. (2) *John J. Berrigan*. 1,350,292. August 24th, 1920.

ROTARY FILTER. *Henry B. Faber*. 1,368,618. February 15th, 1921.

ROTARY CANE CUTTING IMPLEMENT. *Ernest H. Madère*, of Hahnville, La., U.S.A. 1,342,294 July 24th, 1919; June 1st, 1920.

This is a hand implement, provided with an electrically operated circular knife for cutting cane. Referring first to the drawing, *A* represents a blade which is preferably provided with a cutting edge *a* near its forward end but adjacent to the rotary cutter. This blade is provided with a handle *B* through which passes the conducting wires *C* leading to the electric motor *D*. This electric motor *D* is secured to the handle *B* preferably close to the grip thereof, and its armature shaft *d* is connected by a flexible shaft *H* in the tubular casing *H*⁰ to the worm *I* meshing with a worm wheel *J* carried by the



shaft *I* on which the rotary cutter *M* is mounted. The gearing is preferably inclosed in a casing *K*. The electric motor may be started or stopped by means of the switch *N*. To strip the dead leaves from the stalks before cutting the tops or the bottoms of the stalks, a hook *P*

which may be attached to the blade *A* in any convenient way, as by the bolts or rivets *p* is provided. In using this hook the knife is turned through 180°, and the back of the blade is used to knock off trash and the hook is used to clear up the same; moreover, the hook may be used to lift up bent down stalks or to clear out trash or weeds as these occur in standing cane. The current may be generated by means of a dynamo driven by an ordinary internal combustion engine; but where a fixed source of electricity is available, it will be obvious that a long cable may be used with branches leading to the various operators.

In using this implement, the trash is removed by two downward strokes with the back of the knife, one on each side of the stalk; and then turning the knife through 90° the rotary cutter is applied to the cane near the top, cutting off the top thereof. It is then applied to the bottom of the stalk near the ground, cutting the cane at the bottom; while at the same time the stalk is directed by the free hand of the operator into the heap-row. The inertia due to the weight of the motor and attached parts, tend to steady the knife which will, of course, be supplemented by the hand pressure of the operator, and the stalks are quickly cut top and bottom by the rapid rotation of the cutter *M*. When dulled the blade is replaced by a sharp one; and according as the cane is hard or soft, the pitch of the teeth is varied.

PROCESS OF MAKING FRUIT JUICE, FRUIT SYRUP OR FRUIT JELLY. *Maxwell O. Johnson*, of Waipio, Hawaii, T. H. 1,362,868; 1,362,869 and 1,362,870. September 12th, 1919; December 21st.

Fruit juice is concentrated by freezing a part of the water content, separating the juice from the ice, clarifying the juice by heating to a degree sufficient to cause coagulation but insufficient to impair flavour or aroma, removing the clear juice, and sterilizing to prevent fermentation by heating by a lower temperature than that required for coagulation. In making the syrup, sugar is added to the juice before heating, a more complete separation of their impurities being effected than in the absence of this addition, while the liquid is lastly removed from the precipitated impurities. In making jelly, sugar is added after heating to cause coagulation, that is to the clear concentrated juice, and the mixture "jellified."

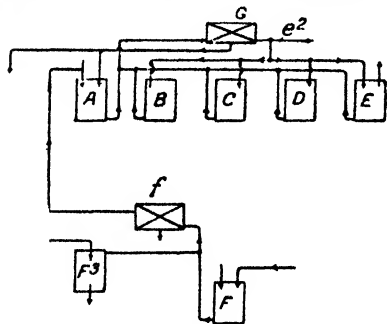
METHOD OF PACKING CONFECTIONERY. *William Derrenbacher*, of New York, N.Y., U.S.A. 1,361,512. March 30th, 1920; December 7th, 1920.

MACHINE FOR WRAPPING CONFECTIONERY. *Jos. P. Remington*, (assignor to *Day and Zimmerman*) of Philadelphia, Pa., U.S.A. 1,362,629. December 4th, 1915; September 14th, 1920.

UNITED KINGDOM.

PROCESS OF PURIFYING LIQUORS, JUICES, ETC., BY TREATMENT WITH DECOLORIZING CARBON, KIESELGUHR, ETC. *Johan N. A. Sauer*, of Amsterdam, Holland. 155,609 (15,601). June 20th, 1919; December 20th, 1920.

This invention relates to an improved process for the purification and filtration of sugar liquids of any character by progressive purification, with successive filtering or separating operations; and has for its object to improve treatments of this character in such a manner as to secure the desired purification with a minimum requirement of decolorizing carbon.



Broadly, the improved process consists in causing a given amount of decolorizing carbon in a fine state of sub-division to act successively upon liquors, liquids or solutions of progressively decreasing purity or increasing colour and all derived from a liquor or juice of the same character or nature by successively passing the batches of liquor or juice in all but the final stage, or the intermediate stages only, through a filtering device containing said carbon and arranged outside the receiving tanks for the liquids; and either in the final stage, or first and final stages, mixing

the said carbon with the liquor, and then again separating it therefrom.

Therefore liquids of progressively decreasing purity all derived from liquid of the same character are passed successively through a filter containing a certain amount of finely-divided decolorizing carbon. The carbon is finely mixed with the most impure liquid, and then separated from it. Referring to the accompanying diagrammatic drawing, the carbon may be supplied initially to the filter *G* or mixed with the purest liquid in a tank *E*. In the latter case the carbon is separated in the filter, the pure liquid passing away through a pipe *e²*. Liquid from tank *D* is then passed through the filter to tank *E*, and so on successively. After liquid from tank *B* has passed to tank *C*, the carbon is discharged to tank *A* and mixed with the liquid therein, separation afterwards taking place in the filter *G* through which the liquid passes to tank *B*. Each liquid instead of being passed once through the carbon in the filter *G* may be circulated through it. The tank *E* is preferably provided with agitating means and with steam coils for heating. The liquid may receive preliminary treatment by means of a decanting apparatus or centrifugal separator *F³* or with a purifying agent in a tank *F*. Kieselguhr, fuller's earth, charcoal, lime, and calcium phosphate, or carbonate, or sulphite and also sodium phosphate, are mentioned as suitable purifying agents for this preliminary treatment. A preliminary filter *f* may also be used.

PROCESS OF PURIFYING LIQUORS, JUICES, ETC., BY TREATMENT WITH DECOLORIZING CARBON, KIESELGUHR, ETC. *Johan N. A. Sauer*, of Amsterdam, Holland. 155,611 (15,606). June 20th, 1919; December 20th, 1920.

The inventor has discovered that when the percentage of the purifying material is increased beyond a certain point, which he terms the "critical percentage," the process is completed to the point at which the liquor has the desired degree of purity, without exhausting the purifying material, that is to say, it is then possible to use the purifying material repeatedly before it becomes exhausted to the point of requiring renewal or regeneration. Furthermore, a considerable saving in the time required for separation or filtration is obtained by this procedure, as well as a material reduction in the amount of purifying agent necessary for the treatment of the same amount of sugar liquor.

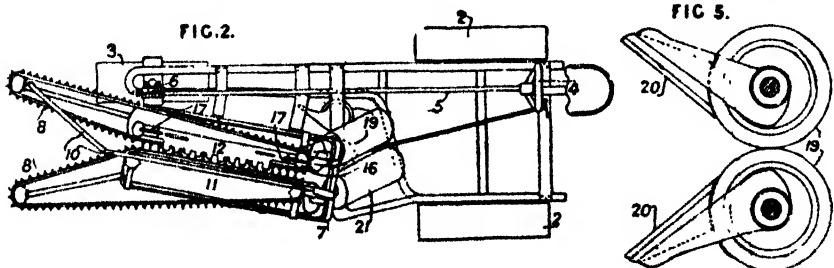
Thus, let us assume that with 10 tons of sugar in the form of liquor of 60° Brix, the best time of filtration which can be obtained by treatment with a certain percentage of purifying material such as finely powdered decolorizing carbon (say $\frac{1}{2}$ per cent.) is 2 hours, and that this quantity is the "critical percentage"; that is to say, the highest percentage

which will yield a practical exhaustion of the purifying material upon the attainment of the desired time of filtration and the desired degree of purification of the sugar liquor. Now, if a higher percentage of purifying material (say 0.75 per cent.) is employed with the same filtering area and the conditions are otherwise alike, the filtration of the same amount of sugar liquid, say 10 tons as assumed above, will require only $1\frac{1}{2}$ hours, and then the same purifying material, instead of being spent, will be available, without any intermediate regenerating treatment, for the like or repeated treatment of a second batch of 10 tons of fresh or untreated sugar liquor of practically the same character with regard to purity and colour, and if the percentage of purifying material is still higher, the same purifying material will do for a third, fourth, or further treatment, acting each time on a like batch of, say, 10 tons of fresh untreated sugar liquor or other liquid of practically the same character as regards purity, or colour. For instance, by increasing the percentage, say, to 3 per cent, the purifying material might be used for ten successive treatments before becoming exhausted, and with this percentage, a much shorter time, say half an hour, will suffice for each treatment. Theoretically, the time required for each of the successive treatments will increase progressively; but the average time required for the treatment of each amount or batch is much less than the 2 hours which was the minimum obtainable when using a percentage of purifying material not exceeding the "critical percentage." In addition to decolorizing carbon, other "purifying materials" mentioned are kieselguhr, fuller's earth, and calcium phosphate, carbonate, sulphate, and sulphite.

Claim 1 is as follows:—The process of purifying liquids, liquors, solutions, juices, liquefied bodies and the like, which consists in subjecting same, by mixing, to the action of a percentage of finely powdered decolorizing carbon, or of any of the other substances hereinbefore specified which is more than is necessary to obtain the final desired degree of purification, decolorization or velocity of filtration, and using said purifying agent more than once without previous regeneration for the treatment of a liquid, liquor, or solution of practically the same character, with regard to its purity and colour.

HARVESTING CANE SUGAR.¹ P. T. Woodland, of Grahamstown, South Africa. 155,023 (22,190). September 9th, 1919.

A machine for harvesting cane comprises conveyor mechanism combined with means for stripping off the leaves of trash and cutting off the tops and then cutting the canes close to the ground. Fig. 2 shows a motor-driven machine mounted on two rear wheels 2 and a front steering-wheel 3 which is steered by means of a hand-wheel 4, rod 5, and gearing 6. The stripping and topping mechanism is mounted on an inclined frame 7.



The canes are collected together, arranged in a thin line, and then drawn between rotary stripping brushes 11 by endless chains 8 provided with projecting fingers and by a rotary jointed rod 10 which is helically grooved. The stalks are bent over by the jointed rod 10 and the tops are cut off by toothed cutters 12. The lower cutter is fixed and the upper one is reciprocated by means of crank-discs 16 and connecting-rods 17. The cutter teeth are rectangular in plan and sharpened on both sides. The apparatus for cutting the canes

¹ See also U.S. Patent 1,365,213.

near the ground comprises two rotary circular cutters 19, Fig. 5, and two projecting fixed cutters 20. The cut canes are conveyed between two rotary brushes 21 which complete the stripping operation. They are subsequently collected and bound into bundles by mechanism on the machine. The fixed cutters 20 may be dispensed with. According to the Provisional Specification, the canes are cut between a rotary circular cutter and a fixed blade curved round it.

MOULDING CONFECTIONERY. *E. C. R. Marks* (*National Equipment Co.*, of Springfield, Mass., U.S.A.). 152,720 (15,575). June 20th, 1919.

A machine is described for moulding chocolate bars, more particularly those containing nuts, means for spreading the chocolate uniformly in the moulds being comprised.

LOZENGE MACHINE. *J. Trenor*, of Burnley. 153,119 (19,780). August 12th, 1919.

MOULDING STARCH BLOCKS. *L. Dare-Mordle and F. B. Shotter*, of Perry Bar, Birmingham. 153,364 (18,867). July 30th, 1919.

COATING MACHINES FOR CONFECTIONERY. *E. C. R. Marks* (*National Equipment Co.* of Springfield, Mass., U.S.A.). 153,541 (21,671). June 5th, 1919.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

UTILIZING COMBUSTION GASES. *F. H. E. Marden* 158,326 (26,601). October 29th, 1919.

FILTERS. (1) *J. Miller and G. Fletcher & Co., Ltd.*, of Derby. 158,337 (27,519). November 7th, 1919. (2) *J. G. McKean and R. F. Jones*. 158,497 (26,025). September 10th, 1920. (3) *A. Tixier* 147,532 (19,516). December 13th, 1913.

REGENERATING HYDROCHLORIC ACID USED IN GLUCOSE MANUFACTURE. *H. Terrisse and M. Levy*. 154,170 (12,751). November 15th, 1919.

EVAPORATOR FEED AND OVERFLOW REGULATOR. *Griscom-Russell Co.* 158,558, (23,539). February 9th, 1920.

EVAPORATORS. *Barber et Fils et Cie.* 158,569 (3373). January 27th, 1920.

CHOCOLATE COATING MACHINES. *A. Sonsthagen*. 158,993 (26,356). November 15th, 1919.

ALCOHOL MANUFACTURE. *Badische Anilin und Soda Fabrik*. 158,906 (4634). February 9th, 1920.

JUICE EXTRACTION. *J. Nicholson*. 159,311 (29,245). November 24th, 1919.

CENTRIFUGALS. *G. C. Barnes and J. R. Morgan* 159,217 (5862). February 19th, 1920.

FERTILIZERS. *D. Lo Monaco*. 159,481 (6434). February 26th, 1920.

REDUCING APPARATUS FOR COCOA, CHOCOLATE, ETC. *E. C. R. Marks*, (*National Equipment Co.*). 159,527 (22,679). September 15th, 1919.

DECOLORIZING AND PURIFYING SUGAR. *D. Grant*. 159,640 (30,541). December 6th, 1919.

LEACHING VEGETABLE SUBSTANCES, ETC. *Electro-Osmose A. G.* (*Graf Schwerin G.*), 145,045 (16,113). January 9th, 1915.

CRYSTALLIZATION APPARATUS. *Soc. Gen. d'Evaporation Procédés Prache & Bouillon*. 159,815 (5890). March 5th, 1920.

SEPARATING GLUTEN FROM STARCH. *Corn Products Refining Co.* 159,838 (7024). March 8th, 1920.

DISTILLATION PROCESS. *Chemical Fuel Co. of America*. 159,880 (7025). March 9th, 1920.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to March 24th, 1921)

	Harvesting Period.	1920-21. Tons.	1919-20. Tons.	1918-19. Tons.
United States—Louisiana	Oct.-Jan. ..	175,000	108,035	250,802
Texas	" ..	6,238	None	4,134
Porto Rico	Jan.-June ..	436,000	433,825	362,618
Hawaiian Islands	Nov.-July ..	527,400	496,183	538,913
West Indies—Virgin Islands	Jan.-June ..	5,000	12,400	9,000
Cuba	Dec.-June ..	4,000,000	3,730,077	3,971,776
British West Indies—Trinidad	Jan.-June ..	60,000	58,416	47,850
Barbados	" ..	50,000	54,279	75,271
Jamaica	" ..	46,000	46,875	43,000
Antigua	Feb.-July ..	13,500	15,540	12,841
St. Kitts	Feb.-Aug. ..	8,000	10,036	10,901
Other British West Indies	Jan.-June ..	10,000	5,651	7,580
French West Indies—Martinique	Jan.-July ..	20,000	22,000	10,027
Guadeloupe	" ..	25,000	25,500	26,604
San Domingo	Jan.-June ..	189,000	175,736	158,309
Haiti	Dec.-June ..	5,000	5,000	3,300
Mexico	" ..	100,000	92,000	70,000
Central America—Guatemala	Jan.-June ..	15,000	15,000	13,441
Other Central America	" ..	20,000	20,000	14,240
South America —				
Demerara	Oct.-Dec. and May-June ..	100,000	96,000	107,560
Surinam	Oct. Jan. ..	12,000	12,000	8,000
Venezuela, <i>exports</i>	Oct.-Dec. ..	20,000	18,000	16,970
Ecuador	Oct.-Feb. ..	8,000	7,000	7,000
Peru	" ..	350,000	330,000	294,500
Argentina	May-Nov. ..	225,000	292,110	130,266
Brazil	Oct.-Feb. ..	300,000	177,155	183,079
Total in America		6,724,138	6,258,818	6,377,982
Asia—Brit. India (consumed locally)	Dec.-May ..	3,000,000	3,049,157	2,370,000
Java	May-Nov. ..	1,485,000	1,335,763	1,749,408
Formosa and Japan	Nov.-June ..	350,000	283,482	415,678
Philippine Islands, <i>exports</i>	" ..	300,000	209,336	195,289
Total in Asia		5,135,000	4,877,738	4,730,375
Australia	June-Nov. ..	175,000	179,176	209,853
Fiji Islands	" ..	60,000	60,000	80,000
Total in Australia and Polynesia		235,000	239,136	289,853
Africa—Egypt (consumed locally)	Jan.-June ..	80,000	90,000	75,899
Mauritius	Aug.-Jan. ..	259,000	235,490	252,770
Réunion	" ..	40,000	32,336	33,273
Natal	May-Oct. ..	160,000	150,000	185,000
Mozambique	" ..	40,000	35,000	20,615
Total in Africa		579,000	542,826	567,557
Europe—Spain	Dec.-June ..	5,000	6,048	6,618
Total cane sugar crops		12,678,138	11,924,566	11,972,385
Europe—Beet sugar crops		3,707,272	2,603,480	3,183,188
United States—Beet sugar crop	July-Jan. ..	935,000	652,957	674,892
Canada—Beet sugar crop	Oct.-Dec. ..	30,000	16,500	22,300
Total beet sugar crops		4,672,272	3,272,937	3,880,380
Grand total Cane and Beet Sugar	Tons ..	17,350,410	15,197,503	15,852,765
Estimated increase in the world's production		2,152,907	....	....

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR. IMPORTS.

	ONE MONTH ENDING MARCH 31ST.		THREE MONTHS ENDING MARCH 31ST.	
	1920. Tons.	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS.				
Germany	783	....	783	....
Netherlands .....	....	345	....	345
Belgium .....	....	....	....	..
France .....	....	....	....	....
Czecho-Slovakia .....	....	....	....	....
Java	14	2	389	16,194
Philippine Islands .....	....	....	....	....
Cuba	49,055	11,901	125,969	11,801
Dutch Guiana .....	....	566	....	638
Hayti and San Domingo ..	..	....	..	....
Mexico .....	....	....	....	....
Peru	3,954	18,728	16,769	41,084
Brasil	1,116	2,991	5,028	23,906
Mauritius	24,158	18,595	77,316	66,278
British India	97	....	1,239	....
Straits Settlements .....	....	....	....	....
British West India, British Guiana & British Honduras	3,323	3,402	13,027	23,267
Other Countries	7,070	1,842	10,848	13,916
Total Raw Sugars.....	89,570	58,372	251,368	197,850
REFINED SUGARS.				
Germany .....	....	..	125	1
Netherlands	1	18,006	971	18,451
Belgium	205	10,435	495	10,532
France .....	....	1,603	2	1,604
Czecho-Slovakia .....	....	138	19	138
Java .....	....	....	5,007	3
United States of America ..	12,263	5,410	56,014	5,567
Argentine Republic.....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	97	15,741	7,324	18,333
Total Refined Sugars ..	12,567	51,833	69,957	54,628
Molasses	18,526	14,040	32,081	20,322
Total Imports.....	120,663	123,745	353,406	272,800

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .....	....	....	....	....
Netherlands .....	....	299	2	657
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	36	175	87	400
Canada .....	....	....	....	....
Other Countries	1	280	6	737
	37	734	95	1,794
FOREIGN & COLONIAL SUGARS.				
Refined and Candy.....	144	3	476	14
Unrefined	4	14	1,232	509
Various Mixed in Bond....	....	....	....	....
Molasses	351	49	829	191
Total Exports.....	536	800	2,632	2,508

Weights calculated to the nearest ton.

United States.

(Willitt & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920. Tons.
Total Receipts January 1st to March 24th ..		547,345 ..	801,008
Deliveries		549,720 ..	799,421
Meltings by Refiners		491,946 ..	632,786
Exports of Refined		58,000 ..	110,000
Importers' Stocks, March 24th		8,677 ..	1,587
Total Stocks, March 24th		113,060 ..	111,440
		1920.	1919.
Total Consumption for twelve months		4,084,672 ..	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

	(Tons of 2,240 lbs.)	1918-19 Tons.	1919-20. Tons.	1920-21. Tons.
Exports		559,339 ..	848,046 ..	337,563
Stocks		562,997 ..	383,296 ..	499,519
		1,086,336	1,231,342	837,082
Local Consumption		20,000 ..	16,500 ..	20,000
Receipts at Ports to February 28th		<u>1,106,336</u>	<u>1,247,842</u>	<u>857,082</u>

Havana, February 28th, 1921

J. GUMA.—L. MEYER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR THREE MONTHS ENDING MARCH 31st, 1913, 1920, AND 1921.

	IMPORTS			EXPORTS (Foreign).		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	182,284 ..	69,957 ..	54,628	324 ..	476 ..	14
Raw	225,772	251,368	197,850	788 ..	1,232 ..	509
Molasses	37,154	32,081	20,322	75 ..	829 ..	191
	<u>445,210</u>	<u>353,406</u>	<u>272,800</u>	<u>1,187</u>	<u>2,537</u>	<u>714</u>
HOME CONSUMPTION.						
	1913. Tons.	1920. Tons.	1921. Tons.			
Refined	173,602	77,816	47,410			
Refined (in Bond) in the United Kingdom	167,264	161,368	257,178			
Raw	24,129	92,910	29,774			
Molasses	7,309	11,594	2,875			
Molasses, manufactured (in Bond) in United Kingdom ..	9,876	20,211	13,573			
Total	<u>382,180</u>	<u>363,899</u>	<u>349,810</u>			
Less Exports of British Refined	6,386	95	1,794			
	<u>375,794</u>	<u>363,804</u>	<u>348,016</u>			

Sugar Market Report.

Our last report was dated 7th March, 1921.

Movements in the home market during the first month of decontrolled conditions have been interesting, apart from the quite considerable extent of the actual trading negotiated. The demand for ready and near-at-hand lots showed no falling off during the greater part of the month, and our Refiners were kept busy with deliveries, whilst supplementary supplies of foreign sugars found a ready market at stiffening prices. Lyle's No. 1 Granulated quoted at 68s. 9d. and Tate's No. 1 Cubes at 73s., show advances of 1s. 3d. and 1s. per cwt. respectively. Czecho-Slovak superior granulated, such as SCH Fine, sold freely from 37s. 4½d. to 39s. 6d. f.o.b. Hamburg, prompt, and further quantities could have been sold up to 40s., had not sellers withdrawn, on account of the necessity of fulfilling engagements of heavy deliveries to France. The keen competition in the restricted market for Cubes has led to a slight reduction in the price of foreign descriptions, ASP, EAR and similar brands being now quoted at 42s. 3d. per cwt. f.o.b. Hamburg, prompt. Good quantities of Dutch, Belgian, etc., Granulated have been taken by the trade, and some American Granulated c.i.f. U.K. ports have been sold at improving prices. At this moment the market is quiet, partly owing to strike difficulties and partly because there is a tendency to abstain from further buying until some of the recent purchases, which are steadily arriving, become absorbed by distribution. The reduction in the stock of white sugar remaining in the hands of the Royal Commission is said to be negligible.

The choice of qualities obtainable has led to a certain amount of cutting in retail prices in some districts: for instance Yellow Crystallized was being sold at 6½d. per lb., but 7½d. for Granulated and 8d. for Cubes may be taken as the general selling price.

After being closed for nearly seven years, the London Terminal market was reopened on 4th April. Contracts for future delivery may now be entered into on the basis of 96 per cent. Cane sugar in bonded warehouse in the United Kingdom, seller having the option to deliver 88 per cent. Beet sugar at 1s. per cwt. allowance, or white sugar at 1s. 6d. per cwt. premium. Prices are scaled to adjust degrees of polarization for Cane, and of analysis for Beet. Naturally prices started wide and nominal, but to-day the first transactions were registered at 25s. per cwt. for Oct.-Dec., and it is hoped that the new terms may lead to a free and widening market. Contracts are registered and guaranteed by the London Produce Clearing House, Ltd., on lines similar to those existing in 1914.

The weather in Cuba is reported favourable for grinding and harvesting. Total receipts to 7th April 1,550,000 tons, compared with 2,025,000 tons last year, whilst the stock stands at 833,500 tons, against 616,046 tons. Present stocks include some 70,000 tons of Old Crop sugar. Centrals grinding 195 against 185 at this date last year. The Cuban Finance Committee now quote both old and new crop sugars at 5.25 cents cost and freight, 5.10 cents f.o.b. Total sales by the Committee to 24th March are given as 151,752 tons for U.S. destinations and 70,500 tons elsewhere. The advance in price has served to stimulate business in the U.S. markets in Porto Rican, Philippine and "full duty" sugars. The Tariff question is still under consideration in the United States, and both Houses of Congress have decided to take up the matter during the present month; this anticipation has led to an active demand for refined in the U.S.

The Java market has been generally quiet and to-day's prices show little change from a month ago, March/April shipment being quoted at 26½ guilders. The Syndicate price remains at 20 guilders for New Crop deliveries, but "second hands" quote May 22½ g, June 21 g, per picul f.o.b. Some business was reported in Whites at 33s. per cwt. c.i.f. U.K. ports for June shipment; there are now sellers at 32s. 6d. for June, 31s. June/July. April/May shipment is offering at 37s. 6d. c. & f. Calcutta, but the demand remains small. Stocks in the three Indian ports are 10,000 tons against 60,000 tons at this time last year, but February shipments, which had been delayed, are now arriving.

Italy and Rumania are said to be desirous of buying. White Javas for Mediterranean ports are quoted at 39s. c.i.f. April/May shipment.

Continental weather has been favourable to the progress of field work, and estimates of the sowings for next crop are awaited with interest. In Belgium opinions are expressed in favour of an increase of 25 per cent. on last year, although the present excellent yield can hardly be reckoned upon. Holland looks for an increase of 20 to 25 per cent., and 15 per cent. has been mentioned for Germany, whilst Czecho-Slovakia is expected to show some increase. These forecasts are interesting, but of course can only be taken for what they are worth at this early date, and reliable computations of the exportable surplus of the next Beet Crops can only be made when the definite estimates become available.

H. H. HANCOCK & Co.


10 & 11, Mincing Lane,
London, E.C. 3,
6th April, 1921.


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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Coal Strike and its Effect on Sugar Consumption.

Since the 1st of April this country has been in the throes of the worst coal strike experienced since the nineties of last century, and at the time of writing something like a deadlock exists in regard to negotiations over the dispute. It is partly a question of wages, but that matter would have been settled ere now, thanks to some offer of Government financial assistance, had the miners' leaders not also been bent on securing certain changes of a radically political and constitutional order which the Government have refused to entertain. So the strike has dragged on for five weeks and the inevitable result has been the gradual throttling down of all trade activity and a great incursion into the ranks of the unemployed, not only from the miners but also from the workmen in the trades most dependent on coal.

The effect on the sugar consumption has been rather pronounced. In the industrial centres of the country the lack of wages has been reflected in greatly reduced purchases, and sugar has been almost a drug on the market. Deliveries have been very gradual, and purchasers of large stocks of sugar from abroad have experienced considerable delay if not inconvenience in disposing of their investments. On the other hand, the refineries have suffered from the shortage of coal; in Greenock all of the five have had to suspend working for lack of the necessary fuel, while the London refineries are little better off, and if the strike is prolonged may be unable to keep going. This lack of ability to refine is shown by the Greenock figures of the last week in April when the meltings were but 1658 tons as compared with 6051 tons in the same week in 1920; it is also exemplified by the fact that deliveries of the still working refineries are said to be restricted to 25 tons per order. But for the fall in consumption, there would be considerable chance for the import of foreign refined; but as it is, there is little or no demand at the present moment. How long the strike will last it is not possible to forecast at the moment, but if things went as favourably as possible it is hardly to be expected that deliveries of coal will be normal again for a good many weeks ahead. This setback to the trade of the country just when there were signs of a permanent recovery is greatly to be deplored.

The Work of Sir Francis Watts, K.C.M.G.

We have just received a further paper written by Dr. C. A. BROWNE, of the N.Y. Sugar Trade Laboratory, on the impressions gained by him in his recent visit to the British West Indian Colonies. Former papers dealing with Demerara and Barbados and other islands will be in the memory of readers: the present contribution deals largely with the activities of Sir FRANCIS WATTS, first as Chemist and then Superintendent of Agriculture in the Leeward Islands and lastly as Imperial Commissioner of Agriculture in Barbados; and we have reprinted elsewhere the short appreciation of his work contained in this pamphlet. When considering the eminent success obtained by Sir FRANCIS WATTS in these latter days, it is perhaps well not to forget that it required many years of patient labour, often under disheartening absence of official encouragement, before his unique knowledge of West Indian conditions and needs, especially with regard to the sugar industry, had been built up. A great deal of this preparatory work was accomplished in a small, wooden, two-storied building right on the dusty road, where there was literally no room to swing the proverbial cat, and the journey on the narrow stairs from one section to the other was more or less perilous to the unaccustomed. Two definite objects were always held in view, judging by what was being done in this small "laboratory" thirty years ago, and these were, first, the erection of a Central Factory for Antigua and, secondly, the foundation of a school for the training of young men of the islands who wished to take up work in sugar factories or on estates. Dr. Watts's laboratory also quickly became the recognized centre for all information of approaching hurricanes, regular observations being made and telephonic messages sent to all parts of the island on the rate and direction of any of these dreaded atmospheric disturbances, thereby doubtless saving many lives and much valuable property. It was always a mystery as to where the room was found for the training classes, but Dr. WATTS soon became the confidant of the planting community with regard to all the manurial and chemical work on the sugar plantations. With the Central Factory at Gunthorpes firmly and successfully installed, the building of an Agricultural College for the West Indies may perhaps be regarded as the coping stone of Sir Francis Watts's life's work, and it is a fortunate circumstance that he will be available to guide this important foundation through its early stages of trial. It is not granted to all of us to pursue plans laid down early in life with such steadfastness of purpose, and it is obvious to all who have followed his career from the beginning that Sir FRANCIS WATTS is endowed in no small measure with that love of his work for its own sake, which is the special endowment of genius, as defined by, was it CARLYLE? "the capacity for taking infinite pains."

President Harding's Tariff Policy.

Without caring to go so far as the fully protectionist policy of the American Republican school of thought, there are many in this country who are frankly tired of the free trade shibboleths of an era that has passed for ever, and would welcome a modification of our fiscal system more suited to the economic problems of the present day. There is still an irreconcilable minority who have learnt nothing from the war, and indeed profess to believe that the lessons of the latter have proved to the hilt the soundness of their hereditary faith; but these are a dwindling number. The majority are prepared, if somewhat cautiously, to consider other means of maintaining our commercial position than have served in the past, and were it not for the fact that a rather large sprinkling of the minority is to be found in the miscellaneous parties who support the present Coalition Govern-

Notes and Comments.

ment, the latter would ere now have made a start with inaugurating some new fiscal legislation. The times are, however, hardly opportune for what would prove very contentious legislation, and the abnormal state of the cost of living leaves a good many men who are not normally keen partisans on the subject disinclined for the moment to consider changes which might conceivably make the present adverse position worse instead of better. When we have got back to more normal conditions, public equanimity will be more favourable to giving new experiments a chance of justifying themselves.

Meanwhile, it is interesting to read the views of the newly elected American President on the importance attached to the latest tariff enactment of Congress by those concerned with the welfare of the United States. Most of the principles enunciated by him would be adopted, even if in more moderate degree, by those who have the welfare of British industry at heart, and they are very applicable to conditions of British trade also. We therefore reproduce below certain sentences from the Presidential message.¹

"The urgency for an instant tariff enactment, emergency in character and understood by our people that it is for the emergency only, cannot be too much emphasized. I believe in the protection of American industry, and it is our purpose to prosper America first. The privileges of the American market to the foreign producer are offered too cheaply to-day, and the effect on much of our own productivity is the destruction of our self-reliance, which is the foundation of the independence and good fortune of our people. Moreover, imports should pay their share of our cost of government.

"One who values American prosperity and maintained American standards of wage and living can have no sympathy with the proposal that easy entry and the flood of imports will cheapen our cost of living. It is more likely to destroy our capacity to buy. To-day American agriculture is menaced, and its products are down to pre-war normals, yet we are endangering our fundamental industry through the high cost of transportation from farm to market and through the influx of foreign farm products because we offer, essentially unprotected, the best market in the world. It would be better to err in protecting our basic food industry than paralyse our farm activities in the world struggle for restored exchanges.

"The maturer revision of our tariff laws should be based on the policy of protection, resisting that selfishness which turns to greed, but ever concerned with that productivity at home which is the source of all abiding good fortune. It is agreed that we cannot sell unless we buy, but ability to sell is based on home development and the fostering of home markets. There is little sentiment in the trade of the world. Trade can and ought to be honourable, but it knows no sympathy. While the delegates of the nations at war were debating peace terms at Paris, and while we later debated our part in completing the peace, commercial agents of other nations were opening their lines and establishing their outposts, with a forward look to the morrow's trade. It was wholly proper, and has been advantageous to them. Tardy as we are, it will be safer to hold our own markets secure, and build thereon for our trade with the world."

The "Times" and Sugar on Trees.

In a longish leading article under the above title, *The Times* recently² gave a resumé of a popular article which had been reproduced in the *Agricultural News*, which had reprinted it from the *Louisiana Planter*³ which in turn had taken it from the *Literary Digest* which had culled it from *American Forestry*,⁴ which had

¹ For which we are indebted to *Facts about Sugar*.

² April 9th, 1921.

³ 1920, 65, No. 13, 307.

⁴ 1920, 25, No. 314, 84-86.

originally published it, the name of its writer being FRANCIS DICKIE. In our opinion the perusal of this leading article in *The Times* would convey to the average reader the impression that the matter was one of some importance, that the discovery of a high quality domestic sugar growing on fir trees had been made, and that here was a possible source worth considering in these days of dear food, though probably incapable greatly of relieving the situation.

One must express surprise that a great newspaper like *The Times*, regarded by most as still the leading organ of our daily press, should publish an editorial of this kind without apparently taking the trouble to ascertain the true value and significance of the information conveyed by it. Its action in so doing seems to us a rather glaring example of "newspaper science." In the case of questions arising in connexion with literature, music, and art, our press generally seeks the more or less authoritative lead of well-known experts in their subject. But in the case of this much-reproduced popular contribution, *The Times* apparently did not resort to the same precautionary supervision; had it pursued the matter a little further, it would probably soon have arrived at the conclusion that the facts were really of purely academic interest only, and obviously of insufficient economic importance to the community generally to be dealt with in the leading articles of a newspaper.

Here are the actual facts: Owing to certain abnormal conditions, viz., drought combined with a phenomenal amount of sunshine, a manna containing a rare sugar forms on the twigs and needles of the Douglas fir tree, as had been noted by Prof. JOHN DAVIDSON, botanist in charge at the University of Columbia, Vancouver. On the other hand, Dr. WEIR stated that he had only seen this manna twice, and doubted whether it could be found in sufficient quantity for collecting. Anyway, a couple of wet days or a few cloudy ones are sufficient to disarrange these conditions, making the exudation of the manna impossible. Even a very light rain washes it off the trees. Regarding the nature of the manna, Messrs. HUDSON and SHERWOOD,¹ of the Bureau of Chemistry, Washington, two years before the publication of Mr. Dickie's article had shown it to contain 75-83 per cent. of the rare trisaccharide melezitose, or melicitose, together with about 11.5 per cent. of reducing sugars and only about 2.9 per cent. of sucrose or ordinary sugar. On eating this manna, it passes into a pasty consistency in the mouth, from which one would deduce the fact that melezitose is much less soluble than ordinary sugar. It appears also to be much less sweet. Finally, it may be mentioned that Messrs. HUDSON and SHERWOOD concluded that this manna from the Douglas fir might prove a good raw material for the small amount of the rare trisaccharide that is required for use in investigation work among chemists, but further than that—as a source of commercial sugar—they obviously refrained from recommending it.

The Cuban Sugar Crop in Arrears.

Mr. R. H. BEATTIE, of the Beattie Central Isabel Sugar Co., writing on March 15th last from Manzanillo, Cuba, gives some data in support of a growing belief that the current Cuban crop is going to fall far below expectations. He states: "I think it will interest you to receive figures of the production of 34 estates here in Cuba up to the 28th of February of this year as compared with their production on the same date last year. These figures were got up by our neighbours, Ingenio "Rio Cauto," and show a loss to date, as compared with last year, of 1,621,600 bags or 230,000 tons, say 37 per cent. These 34 plantations represent the biggest in the island and the most efficient. Their estimated pro-

¹ *J. Amer. Chem. Soc.*, 1918, 40, 1456-1480. See also *I.S.J.*, 1920, 286.

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duction for this crop totals 9,375,000 bags, say 1,339,000 tons, or one-third of the 4,000,000 tons given out by Mr. HIMELY. Taking the total plantations in the island at 190, the other 156 places are supposed to give the other two-thirds of the 4,000,000 tons, but as they include all the small places, the most inefficient, those most backward in starting, and some which have not yet begun to grind, it is reasonable to estimate that their loss, as compared to last year on the above date, will be over 50 per cent., or some 600,000 tons.

"Calculating that the 4,000,000 tons of sugar of Mr. Himely's estimate will need 33,000,000 tons of cane (12 per cent. rendiment), and that one-third has been cut (11,000,000 tons of cane giving 10·50 per cent. to date, or 1,165,500 tons of sugar, one-third of which belongs to the 34 estates above referred to, say 388,000 tons of sugar—equal to 2,748,428 bags), there remain 22,000,000 tons of cane still to grind, and on which we have to count on a loss of at least 2 per cent. in rendiment as compared with last year, or, say, 440,000 tons. Even taking into account that the grinding lasts the usual time, there is a visible loss of some 1,270,000 tons to be deducted from the 4,000,000. If the weather is at all rainy, another 500,000 will easily be lost. Since the 1st of March it has rained a great deal on the island, especially in this the eastern end, and as much as six inches have fallen already in some places, retarding still more the already backward crop. As an instance, I have just heard from Guantanamo that the rains are paralysing the estates up there. They send me a note of the production to the 28th of February, which shows a loss of 50 per cent. as compared with last year."

Summing up, our correspondent concludes that the difficulties the planters are finding in financing their crops make it almost sure that a large part of the cane still to be ground will not be made into sugar, and that the crop may even be reduced to a 2,000,000 ton one. But this would appear in the light of other estimates of later date to be an unduly pessimistic view. The several accredited statisticians are somewhat widely separated in the provisional figures they have so far individually arrived at, but the lowest figure is 2,500,000 while the most sanguine is above 3,500,000. Our usually well-informed American correspondent inclines to a total in the neighbourhood of 3,000,000 tons, and this appears to us much more likely to prove the actual achievement, bar unexpected eventualities. In addition, satisfactory arrangements appear now to have been made for financing the crop by means of 90-day loans, so that the difficulty of completing the grinding has been largely overcome.

The Financial Aspects of the Kelham Factory Scheme.

In the House of Commons last month, on the discussion on Supply, the Minister for Agriculture pointed out that last year there was an item of £250,000 in the Vote consisting of a subscription by the taxpayer towards the capital of Home Grown Sugar, Ltd., the company working the new Kelham beet sugar factory. It was assumed at the time that this contribution from the Treasury, plus the capital subscribed by the public, would suffice to start the factory. But it appears that the costs of working have proved to be a good deal more than was first anticipated, and accordingly the Government are proposing to loan a further sum to assist the venture to make a start. An arrangement had been made by the Treasury that providing the company raised £75,000 themselves as a first mortgage, the Treasury would loan them a further £125,000 as a second mortgage on the assets of the company. In the view of the Government, it was most important that this experiment should be carried through and that the mill should be completed this year in time to deal with the year's crop. From what he had seen, the Minister of Agriculture was convinced that the undertaking was going

to be a success. The Government were setting the example—or were assisting the company to set the example—and if they found that they could make sugar successfully on commercial lines out of sugar beet grown in this country, that would bring about a great change and one that would eventually be greatly to the advantage of the consumer and also beneficial to the farmer as introducing a new green crop into his rotation.

It is unfortunate that besides the originally subscribed and Government-loaned capital of half a million, further capital to the extent of £200,000 has now been found necessary, since it greatly increases the prior charges that have to be met out of the profits in the way of interest on the money. It is satisfactory that the Government having once resolved to aid the scheme are still of the same mind about its ultimate success and attach as great importance as ever to the outcome of the experiment. But whether this optimism will be shared by those who have had experience of beet sugar factories in other countries remains to be seen. In any event £700,000 is a large sum wherewith to capitalize a factory to turn out but eight to ten thousand tons of sugar per campaign. But we suppose it is the penalty of starting a factory at the precise post-war period when the costs of building material and wages have been at their peak. If this factory can be made to pay, those built a few years hence ought to stand a much better chance.

Progress in Jamaica.

The official report on the trade of Jamaica for the year 1919-20, as issued by the Colonial Office, is somewhat brief and scrappy in its references to the sugar industry of the island, but we give the following as the substance. The profitable aspect of sugar production, due to the world shortage, has reacted strongly on the industry in Jamaica, and developments are now in hand that should eventually result in an increased production in the neighbourhood of 100,000 tons per annum, as compared with 15,000 tons in the last pre-war year. Various sugar factories are in course of erection, but difficulty has been experienced in obtaining prompt delivery of the necessary machinery. The general trend is towards centralization, resulting in large central factories with the most modern machinery being established in many localities and many of the smaller estates dismantling their machinery and becoming cane farms, to feed the centrals. The largest of these centrals already established is the Bernard Lodge Central in St. Catherine.

Agriculturally, the year under review was one of low rainfall, large areas suffering from drought in the summer months and from inadequate autumnal rains. Despite these drawbacks, the sugar industry made marked progress with an export of 38,000 tons and a total value of £1,317,547. The rum industry has also made rapid strides since the outbreak of war, the 1919 yield having been 18,415 puncheons, valued at £924,170, as compared with 13,788 puncheons in 1914.

There is an undoubted wave of prosperity (although not amongst all classes) throughout the colony, which is not confined to any one particular class. The spending power of the peasantry has increased considerably, due, in part, to the very considerable sums remitted by the thousands of their relatives in Cuba who are earning very high wages, and also to the highly remunerative prices obtained by those who remain for all products grown in the island.

The Crop Position in Trinidad.

In Trinidad, according to Messrs. Edgar Tripp & Co., unusual rains have resulted in curtailed reaping which, added to the somewhat late commencement of crop, have caused fear in certain quarters as to whether all cultivation can be dealt with before the rainy season finally sets in. On the other hand the growing plants have benefitted and the country fortunately misses its usual parched

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appearance at this time of the year. The wet weather has, however, adversely affected the juice extract which compares unfavourably with that at this time last year. Shipments of yellows are being made to London. The St. Madeleine and Waterloo Factories continue to turn out Greys. Elsewhere, yellow finds favour excepting at Malgretout (under the auspices of the St. Madeleine Co.) where white granulated is being produced with a considerable measure of success. Farmers are being paid \$4 per ton for their canes, with the promise of a further payment under the sliding scale if market conditions justify this latter, and everyone seems satisfied with the arrangement.

The Formosan Sugar Crop—1921 Season.

According to Consular advices to the Department of Overseas Trade, the second estimate of the Formosan sugar crop for the 1921 season, conducted by the Government-General of Formosa, is given as slightly under 4,870,000 piculs (289,881 tons), of which 4,484,640 piculs are centrifugals and the remainder browns. As a result of a typhoon in September last these figures show a decrease of 156,106 piculs for centrifugals and 26,113 piculs for browns as compared with the first estimate. The following table shows the area under sugar and the number of mills:—

	Area under Sugar. Acres.	No. of Mills.	Estimated Production. Kin.
Centrifugals	256,080	41	448,464,033
Browns { Improved mills..	15,060	27	20,862,630
{ Old style mills ..	15,674	189	17,597,941
	286,814	257	486,914,504

In Formosa somewhat gloomy forebodings as to the prospect of the local sugar industry are prevalent. The cost of production of sugar is estimated at Yen 18 per picul in South Formosa and at Yen 20 in the centre and north. Against this it has been estimated that Java and Cuban sugar can be laid down in Formosa at a price, including freight and Customs duty, of about Yen 19 and Yen 21·60 respectively.

The 1920 Sugar Production in Yugoslavia.

According to information supplied through the Department of Overseas Trade, the sugar production of 1920 in the Kingdom of the Serbs, Croats and Slovenes consisted of but 18,670 metric tons, though derived from 8 sugar factories possessing a total capacity of 62,000 metric tons. Since the internal demand is about twice this restricted production, the country has had to import about 18,000 tons further, instead of having a surplus for export. One of the chief causes of this shortage is that the present acreage under beet cultivation is small; before the war the beet grower received payment at the rate of 3 kgs. of sugar per cubic metre of roots delivered to the factory; but the present day rates are said to be much less remunerative.

In order, therefore, to put the sugar industry on its feet, so that it may at least be able to cope with the demands of the country itself, it has been suggested to the Minister of Finance that for every cubic metre of sugar beet used in the factories, 3 kgs. of sugar should be freed from the monopoly tax. These 3 kgs. of sugar would be given to the peasants by the factories as payment in kind. Thus, the cultivation of beet could be intensified, and the productivity of the refineries brought up to their highest capacity. The State would lose about 75 million crowns in duties (300 millions was the total amount obtained from the duty on sugar), but the sugar production would be increased, and react favourably on the price of sugar. This suggestion may be taken into consideration at the Ministry of Finance.

Fifty Years Ago.

From the "Sugar Cane," May, 1871.

FERDINAND KOHN, Consulting Engineer to the Aska Sugar Co., Ltd., Madras, in a lecture delivered before the Society of Arts, London, supplemented the information which he had previously given regarding the operation of the diffusion process of extracting juice from cane.¹ He stated that the average yield of juice was 82-84 per cent. of cane; of sucrose in the raw sugars, 9-10; and of "saccharine matter, etc." in the molasses, 4-4.9, the density of the natural juice being given as 17-19° Balling, and its dilution 15-20 per cent. "These figures when compared with the best practice of colonial sugar factories seem to indicate that the diffusion process is capable of affording an incalculable benefit to the cultivators of sugar cane, and that the advantage to be derived from it in colonial sugar factories are even more important than those which it affords to modern beetroot sugar works. . . . The crop of a cane plantation will therefore produce an increased yield of 19 per cent. when extracted by diffusion instead of being crushed by the mill. . . ." Consideration was, however, given to the disadvantages attached to diffusion, and it was admitted that these might "tend to counteract the advantages of an increased and superior yield." Thus, it was pointed out that there was 15-20 per cent. more water to evaporate; that the value of the trash was lessened; and that a scarcity of water in some localities was a serious drawback. Labour for working the slicing machines and battery was said to be very nearly the same as in mulling; but later experiments carried out in other countries by other writers on this question appear to show that the hands must not only be more numerous but also more skilled than in the case of the crushing operation.

In this number it was stated that a trial had been made in Martinique with the so-called "sucrate of lime" process,² about 50 tons of this compound having been made in the French colony, and shipped to a beet factory in France for extraction there; while other factories were said to be constantly using the new method of working. Another process that was being adopted at this time was that devised by SEYFERTH³ for decolorizing by means of sulphurous acid in the pans during boiling, and it had been taken up by nine *usines* in Belgium, as well as by other factories in Germany, Austria, and Russia. Icery's bisulphite of lime method of clarifying cane juice⁴ had been found by D. W. ARMSTRONG, of Eaton Vale Plantation, Maryborough, Queensland, to give good results. Opinions differed as to whether the reagent should be added before or after the lime; but this writer preferred the addition of 1 per cent. to the juice coming from the mills, followed by cream of lime and clay batter, the liquid being afterwards boiled and subsided. He remarked that he was convinced of its "uncommon efficacy" in converting ill grown and damaged cane into a white sugar which was readily sold at £40 per ton.

Two patents were abstracted in this issue. The first was taken out by WESTON⁵ and related to a modification of his famous centrifugal machine;⁶ while the second concerned a method of using animal charcoal protected by G. PHILLIPS.⁷ Syrup was decolorized in a vessel containing finely ground char, fitted with stirring arms and a double false bottom enclosing filtering material, air pressure or suction being applied in running off, and revivification being effected by treatment with alcohol containing an alkali.

¹ See *I.S.J.*, 1920, 270. ² *I.S.J.*, 1920, 126, 190. ³ *Ibid.*, 1920, 270. ⁴ *Ibid.*, 1919, 428, 1920, 71.

⁵ English Patent, 2550 of 1870. ⁶ English Patent, 3041 of 1867. ⁷ English Patent, 2049 of 1870.

Notes on American Sugar Production.

(From our American Correspondent)

The past month has been marked by a tense struggle between certain of the refiners and the Cuban Sugar Commission for mastery of the market situation. Not all of the refiners have participated in this contest, because several of them have large interests in raw sugar production in Cuba and so are not particularly anxious to depress the price of this product.

Two of the large refining companies, however, holding no direct connexion with Cuban production, have waged war on the Commission since the time of its organization, late in February. They have consistently declined to purchase raw sugar through the Commission, have questioned its legality, and by various means have attempted to break its control of the Cuban supply. With the large amount of Cuban sugar sold on contract before the appointment of the Commission and the free arrivals from Porto Rico and Hawaii and from outside sources of supply, there has been an abundance of sugar on which to draw, and the sales made through the Commission have been much below the current output of the Cuban mills.

The pressure of these other offerings has been such that the Commission has been forced within the past fortnight to reduce its quotations half a cent a pound to 4.75 cents cost and freight, equivalent to 5.77 cents duty landed. This slump in prices, following the advance last month, has again unsettled the market, and has led to a falling-off in demand from the trade.

Within the past week, however, the Commission apparently has re-established its position so far as the Cuban supply is concerned. Reports had been in circulation that the United States Government would protest against its operations, but the Department of State took occasion to deny these reports last week, and caused it to be made known among the Cuban producers that it did not regard the activities of the Commission with disfavour. In addition to this support, members of the Commission have organized the Sugar Finance and Export Company with a capital of \$2,000,000 (£400,000), and have arranged for a loan of \$20,000,000 (£4,000,000) to be advanced to necessitous producers in order to enable them to complete their crops.¹ As the Commission has the active backing of the Cuban Government it is believed that these developments will greatly strengthen its position, and will make it possible for those producers who were financially embarrassed to complete the harvesting of their crops without further interruptions.

While the distributing trade continues to take on sugar in less than the usual volume, and sentiment among refiners and producers remains somewhat pessimistic, those who have carefully examined the situation find in it elements of strength which they believe will lead to an improvement in conditions within the next two or three months.

They hold that the large stocks shown by the weekly statistical reports to be in the hands of Cuban producers include a considerable amount of sugar that ordinarily would be held by distributors of refined at this season. The latter, because of financial conditions and because of the uncertainty which they feel as to the future course of the market, are purchasing only to meet actual demands from week to week. In other words, the view of these trade authorities is that a

¹ Later information states that the loans are to take the form of 90-day acceptances against sugar in Cuban warehouses.—ED., I.S.J.

large amount of sugar which ordinarily would have assumed the form of invisible supplies remains this season as part of the visible stock and that, if allowance be made for this feature of the situation, the amount of sugar to be absorbed is not materially above the normal for this season of the year.

It is admitted that the course of prices from July 1st onward will depend largely upon two factors, neither of which can be accurately gauged at the present moment. The first of these is the final output of sugar in Cuba during the campaign now under way, and the second is the extent to which Europe will draw upon the Cuban supply.

As to the size of the Cuban crop it is generally considered that the month of May will be the decisive period. Ordinarily, the Cuban outturn falls off rather sharply after the end of April, but, should the commencement of the rainy season be delayed longer than usual, it is possible that a large amount of cane may be ground during May, as the quantity standing in the fields is still very great. If, however, the rainy season should set in at the usual date, about May 15th, it is believed hardly possible that the figures of final production can rise much above 3,000,000 long tons, if, indeed, this total is attained.

Following this line of reasoning, it is held that if markets other than the United States absorb 500,000 tons of Cuban sugar, in addition to the quantities already purchased, very little of the current crop will remain to be carried over at the end of the year. In other words, the extent to which Cuba's production exceeds 2,500,000 tons will measure the amount which will need to be carried over into next year if it is not sold outside the United States. There is no evidence that household consumption in this country is much, if any, below that of last year, but the total consumption of the country is expected to be somewhat smaller than in 1920 because of decreased demand from the manufacturing trades.

New York, April 19th, 1921.

The New American Emergency Tariff.

The following are the details relating to sugar that are included in the new United States Emergency Tariff which has been before Congress the last few weeks. This Bill is identical with one presented last season, but vetoed by President Wilson.

The new rate is, in effect, 2 cents per lb. for 96° test sugars; but Cuban sugar will come in as heretofore at 20 per cent. reduction, i.e., at 1.60 cents per lb.

ARTICLE.	RATE OF DUTY.	
	OLD.	NEW.
Olive oil in containers of less than 5 gallons	30 cents ..	50 cents
Sugars, tank bottoms, syrups of cane juice, melada, concentrated melada, concrete and concentrated molasses, testing	per lb.	
by the polariscope not above 75°	1 $\frac{7}{10}$ cent.	1 $\frac{1}{10}$ cent.
and for every additional degree shown by the polariscope, in addition	1 $\frac{2}{100}$ cent.	1 $\frac{1}{100}$ cent.
and fractions of a degree in proportion.		
Molasses testing not above 40°	16% <i>ad val.</i>	24% <i>ad val.</i>
Molasses testing above 40° and not above 56°	per gallon 2 $\frac{1}{2}$ cents ..	3 $\frac{1}{2}$ cents
Molasses testing above 56°	4 $\frac{1}{2}$ cents ..	7 cents

Sugar drainings and sugar sweepings shall be subject to duty as molasses or sugar, as the case may be, according to polariscopic test.

An export tax on sugar exported from Mexico, which has been operating for some time, has now been withdrawn by a Mexican Governmental Decree.

The Work of Sir Francis Watts.¹

By C. A. BROWNE.

The early work of the Antigua laboratory, when Dr. WATTS assumed charge in 1889, was begun in great isolation and under enormous difficulties. The laboratory appliances were meagre, there was no gas, the library consisted of only a few general works, and there was no consulting staff of scientific co-workers; yet this lack of equipment, denoting as it did the complete absence of any pre-determined governmental policies, left the laboratory free to develop along natural lines and to take up the industrial and agricultural problems of most immediate and pressing importance. The great benefit of the laboratory was quickly felt and the scope of its work was widened when, with the establishment of the Imperial Department of Agriculture for the West Indies in 1898, the local Antigua laboratory became a federal institution, with its field enlarged to comprise St. Kitts, Nevis, Montserrat, and the Virgin Islands. Immediately preceding this, Dr. WATTS occupied for about a year the position of chemist to the government of Jamaica, but relinquished this post after the creation of the Imperial Department, to accept in 1899 the appointment of government chemist and superintendent of agriculture for the Leeward Islands. He retained this position until January, 1909, when he was appointed to his present office of Imperial Commissioner of Agriculture for the West Indies.

From the beginning of his scientific career in the West Indies, Dr. WATTS has maintained a close contact between the chemical laboratory and the Agricultural and Botanic Experiment Stations, and he has continued this policy of scientific co-operation in all his subsequent administrative work. The effect of this has been most beneficial, as results were secured which could not have been accomplished had chemical, agricultural, botanical, and industrial research proceeded along separate unassociated lines.

The training of young students for the varied needs of industrial life in the tropics is a subject to which the Imperial Department of Agriculture has given much attention, and a considerable amount of Dr. Watts' time in late years has been devoted to questions of education. In addition to their usefulness as centres of research, the experiment stations and laboratories have been made to serve as training places where young students may acquire practical first-hand knowledge of the subjects taught in the elementary and secondary schools.

With the recent rapid growth which has taken place in developing the resources of the British West Indies, a strong need has been felt for a central higher institution of learning where advanced students could obtain a complete theoretical and practical training in the production of sugar, cacao, rubber, and other agricultural commodities. The new Tropical College, for which Sir FRANCIS WATTS has so long been working and which is soon to be established in the island of Trinidad, will remedy this need. Trinidad is an ideal location for the new institution, for not only is it conveniently situated with reference to the colonies in the West Indies and British Guiana, but with its varied industries of sugar, cacao, rubber, limes, and copra, as well as of asphalt and petroleum, it offers the student almost unlimited natural facilities for study and research. This college will be of much benefit to the Empire as a whole, as well as to the colonies most immediately concerned, for up to the present time the graduates of English

¹ Extracted from "Industrial and Agricultural Chemistry in the British West Indies with some Account of the Work of Sir FRANCIS WATTS, Imperial Commissioner of Agriculture." *Journal of Industrial and Engineering Chemistry*, Vol. 13, No. 1, page 73, January, 1921.

universities who take up scientific work in the tropics have lacked facilities for acquainting themselves with the requirements of their new duties.

The committee who have the matter in charge regard it as desirable that an intimate relationship should exist between the Tropical College and the Imperial Department of Agriculture, and have recommended that the first president of the new institution should be the Imperial Commissioner of Agriculture. The wide experience of Sir FRANCIS WATTS in the agricultural, industrial, and educational life of the West Indies is sufficient proof of the wisdom of this recommendation. While the administrative duties of Sir FRANCIS have obliged him to withdraw from active work in the laboratory, his original interest in chemistry has continued unabated, and it is safe to predict that under his leadership chemical research, as a means of developing the industrial and agricultural resources of the tropics, will find an important place in the curriculum of the new college.

Cane Cultivation in Dutch Guiana.

The temporary eclipse which has befallen the beet sugar industry has caused the area under sugar cane to steadily increase in all parts of the world, where there is room for expansion. Cuba, Porto Rico, San Domingo, the Philippines, Mexico, Brazil, and British Guiana, have large areas which may still be drawn upon, while this is less so in Hawaii, Java, Mauritius, and the smaller Antilles. In the latter series of countries the industry has been long established, and present efforts are more to keep up the high standard reached than to effect great improvements; while in the former great countries the fact that there is always plenty of room for expansion has resulted in a certain backwardness in cultivation if not in manufacture. With these great new competitors coming into the arena, it is well occasionally to take stock of the natural resources, the "essentials of sugar production," on which the industry has been built up. Taking a broad view, it is natural to suppose that countries richly endowed as regards soil and climate in the tropics will not always be in the background, and not so far hence may seriously challenge the supremacy of those which are reaching the limits of their productive powers, where the land is becoming worn out and where, besides this, the natural conditions are less favourable. For instance, an interesting comparison may be drawn between Dutch Guiana and Java, two of the chief Dutch colonial possessions, on the one hand, and the British West Indies and Demerara on the other. The comparison has been somewhat elaborated by Dr. F. A. F. C. WENT, formerly chief of the Java Experiment Stations, after a visit to the West Indies some years ago; and as this paper,¹ being in the Dutch language, may not have been met with by the readers of this journal, some of its details have been here put together.

There is often a great difference in the character of the cultivation in countries near to one another or under the same Government, and this may be traced primarily to density of population. A case that will readily occur to the reader is that of Barbados and Demerara, and a still more telling instance is found in a comparison of Java and Surinam. In Barbados and Java sugar cane land is limited, the native population is numerous and industrious, and every portion of the land which is suited to sugar cane is sedulously cultivated. In Demerara and Surinam the converse is the case: there is plenty of excellent land available, but

¹ Waarnemingen en Opmerkingen omtrent de Rietsuikerindustrie in West Indië.
S-Gravenhage, Algemeene Landsdrukkerij.

Cane Cultivation in Dutch Gulana.

paucity of labour prevents this from being taken up. In these two instances excellent examples of intensive and extensive cane culture have been evolved respectively. The great cultivated areas in Surinam are so-called "polder," that is drained marsh, along the banks of the great rivers, which, being low-lying, need embankments to prevent their being flooded. This is all the more necessary as the cane estates are situated near the mouths of the rivers, where the water is more or less brackish from the mixture with salt water. Not only has this river water to be kept out, but embankments have to be raised against the storm water coming from the forest behind the plantations. Throughout the cultivated portion, great drains are dug with sluices at their ends which can be opened at low tide to get rid of superfluous water. These features make the cultivation peculiar and expensive.

The rainfall is heavy, that at Marienburg where the largest area is under cultivation, for the five years 1895-1900 as recorded, was 82 in., 72 in., 95 in., 57 in., and 100 in. : the year 1899 was exceptionally dry. This rainfall corresponds fairly well with that in the sugar tracts in Mid- and West-Java, but it is of very much greater value to the crop because of its even distribution throughout the year. The average rainfall for the ten years 1893-1902 was 92.00 inches and this was distributed during the year as follows :—Jan. 7.2, Feb. 7.6, Mar. 10.0, Apl. 9.2, May 11.6, Jun. 12.6, Jul. 8.4, Aug. 6.4, Sep. 3.2, Oct. 3.0, Nov. 4.8, Dec. 8.0. It is seen from this that only two months in the year have a low rainfall (by no means contemptible elsewhere), namely September and October, but this is of little consequence and quite insufficient to cause a check in growth, because the ground is so well stocked with water from rains in the preceding months. And even if there were danger of such a check, Dr. WENT points out that it would be extremely easy to make use of the embankments in the upper parts of the fields for the preparation of "tanks," from which all the lands on the estate could be irrigated by ordinary flow.

In taking up new land the procedure is extremely simple. The forest is cut, the valuable timber drawn out and the rest distributed and evenly burnt, leaving a thick layer of fertile ash over the field. The soil, which is a heavy clay, is furthermore much improved by this burning and plenty of humus is still left in it. It appears to be extremely fertile and, with barely any cultivation and no manure, yields heavy crops. Embankments are then raised and the canals cut : the Reynoso system is followed in the working of the land with very deep ditches at intervals, in the bottom of which there is always water standing. At the time under report only *Bourbon* cane was planted throughout the Colony : the rows are widely separated, nine or even twelve feet apart, and as extremely luxuriant growth takes place there is considerable difficulty experienced from lodging of the canes : furthermore, roads are far apart, so that it is difficult to get into the fields to raise the fallen canes. All the cultural operations appeared to Dr. WENT to be of a slovenly nature when compared with those in Java : the earth taken out of the deep ditches, for instance, is left roughly heaped up, but this seems to make no difference in the crop which is heavy and of a deep green colour ; and because of the cost of labour no attempts at perfection are aimed at.

Tops are used for planting, thereby connecting the milling and planting seasons closely. This connexion is often very prejudicial, in that plants are put in at the worst time and canes are sometimes reaped when under or over ripe. Dr. WENT, fresh from Java, suggests the propriety of founding nurseries (which could be easily done) and thus rendering the plantation independent of the factory. Weeding and cultivation are on a primitive scale, the fork being the chief instrument used,

but, what is most important, the yields are very good; new land under plant cane gives usually 5 tons of sugar per acre and, taking the average of plants and ratoons, from 3 to 5 tons are obtained. The land is generally cultivated for six or seven years, when it is renovated. The system of doing this is peculiar. The land is flooded, and a great crop of grasses, sedges and certain weeds springs up, giving place later to masses of dwarf trees, chiefly of the *Cecropia* type. After four or five years the water is let out, and the land cleared and planted, when a greatly increased yield is again obtained. Owing to the meagre cultivation afforded, planters are not much in favour of ratoons, and when there is labour it is found better to replant as often as possible, thereby increasing the yield. But it is also stated that the first ratoons are very little inferior in luxuriance to the plant canes and the second are not far behind, so that perhaps the increasing foulness of the land may be an important factor. Thashing the canes is universal, without any tangible reason being given for it; the trash is regularly turned in, as it makes the heavy soil more easily workable and keeps up the quantity of humus for a longer period. In older lands cattle manure and superphosphate are given, again without any experiments having been tried as to the economy of this form of manuring as compared with others that might be tried. On reviewing this agricultural practice, it would almost seem that to introduce better methods after experimentation is hardly worth the trouble, as the conditions of soil and climate are so favourable that it does not matter very much what is done!

Transport at Marienburg, where there are some 1600 acres under cane at a time, is by tramways connected with a permanent railway line with engines; elsewhere throughout the colony advantage is taken of the canals and the canes are taken to the factory, just as in Demerara, in flat bottomed boats. The sucrose in the canes is, naturally, under such moist conditions, not very high, but it does not seem to be very bad, as 9.8 tons of cane produce one of sugar, and the industry is capable of great expansion if labour were available. Dr. WENT advocates the installation of a small experiment station where new kinds of cane can be tried, methods of cultivation investigated and other manures than those used in the colony properly tested. It would be interesting to learn if this has been done, and especially if the Bourbon cane is still growing so luxuriantly as it was in the early years of the century.

The other Dutch Colonies in the West Indies are Eustatius and St. Martin, both of them very small, and Dr. WENT discusses the possibilities of establishing a central factory in either; but, from one's own knowledge of these small islands, it does not appear to be probable that there is room for such ventures. He visited Demerara, Trinidad and Barbados, besides seeing some very primitive cane growing in Venezuela. The general result of his study of manuring in Demerara and Barbados, as compared with that in Java, is that each and every country should make its own experiments in the matter, for the accepted practice in these three places is so hopelessly at variance that a general scheme applicable to all is out of the question.

C. A. B.

In view of what has been written in our pages on the value of tree planting on sugar estates,¹ it is regrettable to learn that in Jamaica there is no Forestry Department and the cultivation of timber trees is an unknown industry. Almost all the timber which clothed the plains, and much of that which clothed the hill slopes up to 2500 feet above sea level, and in some places up to 4500 feet has been destroyed. In a few places destruction has extended to a higher elevation than 5000 feet.

¹ *I.S.J.*, 1920, 131.

White Grub in Queensland Cane Fields.

In our last issue the 20th Annual Report of the Queensland Experiment Stations was briefly summarized as regards the agricultural experiments being carried out: in the present issue we refer in some detail to the important note appended by Dr. ILLINGWORTH on the great fight being waged against the white grub, *Lepidiota albohirta*, which is becoming a vital factor in the local industry. The matter is not an easy one because of the long stretch of coast line which forms the cane tract, for the beetles live naturally, and in enormous numbers, on the grass lands which are everywhere to be found further inland, and from which a constant succession of seasonal invasions takes place. One is thus in a sense powerless, and the only practical course is to make the cane fields as inhospitable as possible for the immigrants, whether by poisoning the land, removing those trees which serve them as temporary feeding grounds, or thoroughly permeating the cane tract with natural enemies which in other countries serve to keep white grubs in check. The work of the year was of course seriously hampered by the prevailing difficulties of the industry: shipping disagreements seriously retarded the arrival of necessary chemicals and stores, the prolonged drought which extended to the middle of January, 1920, hampered the experiments laid down and, when the rains came, they did so with such vigour that a great deal of damage was done all over the sugar tract. In spite of these and other hindrances, solid work has been done and some marked progress made, but Dr. ILLINGWORTH reports that final results will be delayed for at least a year longer than was anticipated. It is a fortunate circumstance that, just as in cotton cultivation, there is a tendency in the sugar cane for one or two pests to be dominant at any one period, so that all the energies of the entomologists can be concentrated on comparatively few problems. Two beetles, the white grub and the borer beetle, are however quite sufficient to test to the utmost the capacity of the small band of entomologists engaged by the Queensland Government for what is practically the salvation of its cane industry, and it is a serious question whether the funds devoted to the investigation are at all adequate from a business point of view.

Dr. ILLINGWORTH, the chief of the small band of workers on cane grub research, has adopted the excellent plan of issuing a monthly report of the progress of his work, one of which was briefly referred to in our January number.¹ And at intervals these monthly reports are collected and printed in the form of Bulletins, so that a permanent record is available for study by local planters and entomologists engaged on similar researches in other parts of the world. We have recently received the third of these bulletins of collected papers on the investigations of the pests of the Queensland cane fields, covering the period from July, 1919, to June, 1920, and extending to 39 pages of interesting matter. There is thus already a large amount of literature available, and the *raison d'être* of the various steps taken and conclusions arrived at can be readily followed by those specially interested in the subject. This mass of published matter has enabled Dr. ILLINGWORTH to concentrate, in his note appended to the Annual Report of the Department, on certain aspects of the campaign against white grub, and it is with these that we shall deal in the present article.

The results of the cultural plots laid down at Meringa during 1917 and 1918 are first somewhat fully dealt with. Ten acres were laid down in 14 experiments with control plot, for testing various treatments to stimulate growth and to render the soil unpalatable to white grub. As in other experiments in Queensland the drought seriously handicapped the work, rendering a specially prolonged cultivation period

necessary to enable the canes to grow at all, as the site selected was towards the top of a hill on red volcanic soil with perfect drainage; and such prolonged cultivation is recognised, in itself, as one of the most useful methods of fighting the pest. Among the experiments, full advantage was taken of the known poisonous action of all forms of arsenic on white grub, even in very small quantities in the soil, and important conclusions were arrived at as to the best form in which this should be applied, whether as white arsenic, sodium arsenite, or lead arsenate. The arsenic was given at the rate of only 10 lbs. per acre in these experiments. It was either applied directly to the soil, sprayed on weeds or beans afterwards ploughed in, or given together with ammonium sulphate or meatworks manure; beans, nitrate of soda, meatworks manure and lime were applied alone, and one plot was given meatworks manure and nitrate of soda. The results obtained in each of the 15 plots are given in tons of cane and the percentage in the cane of "commercial cane sugar"; and in another table the effect of each separate substance is summarized as to gain or loss in tons of cane. Dr. ILLINGWORTH then draws the following conclusions which are given in his own words: "Most surprising, meatworks manure appears to be very detrimental to this type of grub-infested soils. Not only the cost of the fertilizer and its application, but, more important, is the material decrease in the crop. This evidently is explained by the fact that the manure is attractive to the pest. The relative value of the various forms of arsenic is also important; it is very interesting to know that the common white arsenic (arsenious acid), which is cheapest and most easily applied, is the most effective. Apparently it is not wise to apply sulphate of ammonia until after the rains began. These results, however, should not be taken as an indication that this fertilizer is not valuable for cane, for it is generally recognized that it gives remarkable stimulus when properly applied. We should remember, too, that this is a home product, and by proper handling it has even a higher nitrogen value than the imported nitrate of soda. In any case, best results are secured on land which has had a dressing of lime (calcium carbonate preferred), but the two should not be applied at the same time. Nitrate of soda, on the other hand, is apparently not so easily lost during a period of drought; at any rate, the results on the crop were apparent. The value of the green crop on these soils was also very noticeable, for they are poor in both humus and nitrogen, which are supplied by the beans. Lime, too, gave evident results which doubled the money put into its application."

The various methods of control thus far found to be useful are next discussed and the results brought up to date. The muscardine fungus destroys vast numbers of the pest under favourable conditions, which appear to be cool, damp weather. On the Greenhill Estate, Dr. ILLINGWORTH records that late in the season he found 37.5 per cent. of the well-developed grubs infected, while in some places a little later as many as 100 per cent. of the grubs had been attacked and destroyed by this fungus. It is natural that, with such a powerful ally, attempts have been made to spread the contagion artificially. Large quantities of spore laden material are readily produced in the laboratory, by being grown on some starchy substance, and the model chamber used in Trinidad was adopted. As however rice, which was used successfully there, was much too expensive, new media had to be sought; and with corn meal ideal cultures were readily obtained. The infected material was scattered in furrows made in grub infested land; but, as has so often been the case elsewhere, it turned out to be impossible artificially to follow nature in this matter. In no case was there any recognizable advantage from the addition of laboratory material. This is put down temporarily as due to the abnormally dry weather, but it is quite possible that some other factor connected with the state of health of

White Grub in Queensland Cane Fields.

the grubs themselves may have to be taken into account. The failure is probably not of as serious a nature as might first appear, for, given the necessary conditions, the grubs are readily attacked, showing that the soil is largely impregnated with the spores already, and further laboratory assistance may thus prove of little real benefit.

Hand-picking, the mainstay in many earlier visitations of insect plagues, has become so expensive in Queensland as to be practically ruled out. But there is some reason to suppose that this is not after all of such very great moment. Every fertile female caught will doubtless diminish the total number of eggs laid, but, when we remember that there is an unending series of fresh flights from the grass lands, we can readily believe that the proportion of beetles handled by this method forms a very small proportion of the invading hosts. It is not a question of once for all freeing the land of the pest, but the expense will have to recur indefinitely; fresh flights will come year after year or season after season from the natural habitat of the beetles, against which an eternal battle must be waged.

Arsenic is now known to be a deadly weapon against the white grub in the soil, and receives a great deal of attention. It destroys the grub especially when contained in the humus, while experiments have shown that even when applied in such large quantities as 70-80 lbs. per acre it has no effect on the juice. The experiments were vitiated by the drought, the arsenic placed in furrows near the base of the row being apparently out of range, because of the small amount of travelling of the grubs in the dry ground. Good results were obtained elsewhere by putting the poison in the rows before planting, and therefore a number of stools were lifted bodily, the arsenic dusted in and the stools replanted. The result was highly encouraging. By lifting sets of stools in turn at different periods the rate of progress of the disease was estimated as follows: In 4 days 14 per cent. of the grubs were dead, in 7 days 24 per cent., in 10 days 34 per cent. and in 20 days as many as 70 per cent. were destroyed. The application was 80 lbs. per acre, and to settle all doubts the stalks were analysed, but showed no trace of arsenic when subjected to the most careful chemical analysis. Of course this experiment is very like dusting the grubs direct, but that is just what is the aim of the treatment. Presumably both furrow application in normal weather and dropping in the trench will be tried again with different strengths of arsenic; the latter is the only method applicable for ratoons and should therefore receive first attention.

The destruction of feeding trees around the cane fields has for some time been known to be beneficial in controlling white grub. This matter is discussed at some length, and, as an example, the history of the Greenhills Estate is traced from first being put under cane in 1903 to the time of writing the Report. Great benefit seems to have been derived in yield of cane whenever the brush was cleared. It is to be noted that the favourite food of the beetles is the young growth, so it is necessary to destroy the trees completely if the trouble of annual lopping is to be avoided.

Further information has been gained regarding the introduction of insect parasites of the white grub. Through the generosity of Mr. MUIR, the Entomologist of the Hawaiian Planters' Association, an attempt was made to introduce *Scolia manilae*, which had proved so effective in that island. A fine consignment of 600 females was got together and brought as far as New Zealand, when the delay caused by a shipping strike proved too much for them and they all died. Java is now looked to for further attempts, as the white grubs of the cane fields there appear to be kept in check by a number of natural enemies.

C. A. B.

Note on the Influence of Bagacillo, and the Treatment of the Low-grade Masecutes.¹

By HERBERT WALKER.

I believe it worth while to try and get a mixed juice as free as possible from small particles of bagasse, as it seems very probable that the action of heat and lime may extract from them gums and other substances which are not conducive to the best results in the boiling house. The extent of the harm done by this fine trash and the additional expense warranted for its removal still remain to be demonstrated.²

An additional advantage of a better system of screening might result from the increase in fuel obtainable. If we could recover even 0.2 per cent. of bagasse from our mixed juice, our factory would have about 500 tons more fuel available per year, worth over \$1000.

As to the disadvantages of removing *bagacillo*, a certain amount of inert material is an aid to filtration, as is shown by the use of kieselguhr in refineries, but, like kieselguhr, this "filler" need not be especially coarse in texture, and I do not believe the use of even a 100-mesh screen on the mixed juice would hurt filter-press work. I have heard of attempts to improve poorly filtering mud by the addition of fine trash, but they have not proved successful.

The continuous return to process and repeated reboiling of molasses is generally supposed to produce gummy, viscous substances which are very objectionable in the boiling house. While this belief seems very logical, like the effect of *bagacillo*, it is still subject to proof. I do not see how "re-processing" can influence the ash content of our shipping sugars one way or the other, as "ash" is neither removed nor produced by the boiling process. If we were trying to make white sugar or raw sugar as high in polarization as possible, we might make our No. 1 masecutes from straight syrup without the return of any molasses at this point. At present we are obliged to reduce the purity of our No. 1 masecutes and leave enough molasses on the sugar crystals to bring down the polarization to an arbitrary limit. Thus, the amount of ash in our raw sugars is determined almost entirely by the amount existing in the clarified juice and the polarization of the sugar.

It would certainly be highly desirable to make a high purity low-grade sugar and a low purity final molasses. Unfortunately, we have here two opposing conditions. A larger grain would facilitate the drying of low-grade masecutes and make for a better low-grade sugar. On the other hand, a large amount of crystal surface is desirable to facilitate crystallization and get an exhausted molasses. Since the surface area of a given weight of crystals varies inversely with their diameter, it is impossible to have in the same purity masecuite the two desirable features of large grain and large crystal area. If we double the size of the grain, we reduce the total number of grains to one-eighth and their surface area to half the original. The purity of the final molasses is of more importance than the size of the low-grade grain. We hope to improve the latter, but to do so will require slower boiling and longer crystallization, hence more pan and crystallizer capacity.

It is unsafe to judge the amount of molasses re-processed by the purity of the remelt alone. A factory working a 52° purity masecuite, and getting 75°

¹ Report presented to the Committee on the Manufacture of Sugar and Utilization of By-Products, appointed by the Hawaiian Sugar Planters' Association, September, 1920.

² Cf. Mr. Peck's report on the subject, *I.S.J.*, 1921, 158.

Note on the Influence of Bagacillo.

purity sugar from it, is returning less molasses to process than one working 60° purity massecuite and getting 80° purity sugar. As a further illustration take:

60 purity massecuite yielding 80° purity sugar ;					
56	"	"	"	76.3	" "
52	"	"	"	72.5	" "

In each case 70 per cent. of the total molasses present is separated in one operation at the centrifugals, returning 30 per cent. to process to be worked over again. Thus, the total molasses handled in order to separate 100 parts molasses is $100/0.7 = 143$; or, for every 100 parts molasses originally boiled, 43 parts have to be returned and reboiled.

Meditations on Trapology.

The Rôle of the Steam Trap in the Sugar Factory.

By J. O. FRAZIER.

Sugar Engineer, New Orleans.

I.

Perhaps no other sugar factory accessory, coming under the head of what might be called refinements and of equal value, has received so little earnest study of structure, office, adaptation and economic value as the Steam Trap.

The persistence in manufacture, variety of type, extent of use and persistence in seeking proper adaptation, are strong indications of basic utility. The number found abandoned for others or none confirm the opening assertion. The general fact that no contrivance of low utility could long continue on a modern market argues strongly for merit. In the largest number of cases of abandonment the trouble lies in lack or proper understanding of adaptation or neglect rather than in inherent fault of the machine.

The word *trap* has such wide application that it becomes necessary to add some prefix to indicate its office. The very word itself implies strategy of some sort taking something unawares. Paralleling the persistence of "black lead" for leadless plumbago is that of "steam traps" for what really are water traps ; the water is trapped into its reservoir or through the outlet valve instead of the steam. If one were called upon for some precise definition of what a steam trap really is, it would be an "automatically variable opening." This again applied to the multitude of steam traps in use would show that some vary the time of opening, others the extent of valve opening and still others a combination of these two factors.

Primarily, condensation of steam is what makes steam traps necessary. This condensation ranges from the moderate quantities in piping systems, together, often, with entrainment from the boilers, to that in sugar factory heating coils and calandrias where efficiency depends upon high rates of condensation. In steam piping condensation is dangerous to the steam cylinders on its accumulation, and in evaporating apparatus dangerous to high efficiency. Finally, the variation in rate of condensation in all these situations is what makes necessary some automatically variable opening for its release. The situations in which steam traps are applicable are only limited by the number of vessels containing steam.

The narrowest generalization of steam traps into class is into the *return* and the *non-return*. Each of these takes its class name from the character of its service, and, by "return" is implied a return of condensation to the boilers, and the "non-return" with delivery elsewhere. In a general way also, all steam traps

come under one of the two heads as to operation : either continuous or intermittent. All return traps are intermittent for reasons developed further along; all "expansion" traps are continuous and the larger number of non-return traps of the so-called "pot" class are intermittent. Again no return trap can receive and discharge at the same time; this class therefore easily lend themselves to measurement of the water handled. Practically all non-return traps may receive and discharge at the same time, and therefore do not permit of measuring their output by trap movement.

It is to be primarily understood that when all other conditions are equal, the capacity of any steam trap, all of which discharge from force behind the water, is directly proportional to the pressure in the vessel drained; again, that these pressures are often variable, as well as the rate of condensation. The net opening then required becomes a product of extent of opening, time opened, pressure of discharge and rate of condensation. To automatically secure a release opening accurately responsive to all the above variables, offers, it is easy to see, a very wide field for the application of many mechanical movements among what might be called the valve harness.

Makers of steam traps, especially American makers, feel called upon to furnish a capacity table for their various sizes. As above outlined, variations of pressure seriously affect such values, and there are several minor elements involving resistance to flow in the water movement. The result of these is that no precise allotment of capacity is possible except under certain specified conditions of pressure. Even if all the appreciable elements of working conditions be equal, there yet remains the practical impossibility of precisely duplicating a given installation. Friction of water movement, essentially composed of pipe length and angles in same, may seriously disturb the equal delivery of two machines apparently alike in size and equipment.

The distinctions of service determining the choice between a return or non-return trap for a given service are essentially based upon the quantity, temperature and purity of the condensate. The larger this quantity, the higher the temperature and the determining pressure, the more important the immediate return to the boilers with the return steam trap, provided only that the condensate be of proper purity for boiler feed. Usually the condensations from sugar evaporating apparatus are of proper purity, saving only an occasional oiliness from such as are derived from exhaust pressures. With sugar juice evaporating apparatus, all of whose condensate is large in quantity, the field for the use of the return steam trap is especially inviting.

While fundamentally simple, as is shown further along, the installation of return trap systems, compared with that of non-return is considerably more complex and costly. However, in the range of duty performed, the service may be stated as double that of the non-return trap system. Both classes, functioning properly, perform the primary service, that of drainage, equally well. The direct and immediate return to the boilers of condensation from the return steam trap may, in many cases, more than double the value of the service. There is a shorter time cycle from the departure of steam from the boiler as steam to its return as boiler feed than is practicable by other methods. A complete system, it may easily be seen, would form a continuous short time circuit through the boiler and heating apparatus and a practically immediate balance of feed supply with steam demand, leakage excepted.

The return steam trap being so generally less well understood than the universally well known and used non-return, it seems proper to analyse quite fully

Meditations on Trapology.

the possibilities of application as well as method of adaptation to quite a variety of service. The economic basis of return steam trap application is the return to the boilers of feed at higher than usual temperatures. A primary justification for its use is that when steam has lost its latent heat—been condensed regardless of pressure, its logical destination is the boiler to receive a further heat charge. Having lost the lion's share of its heat value this should be restored in the shortest possible time, keeping in mind that a heat unit has a fixed value wherever available for use, also that the higher the temperature of boiler feed the greater the boiler freedom from expansive shell movements.

Even with such advantages there are many considerations involved in the advisability of application to any given situation of a return trap system. Also, while the general principles of adaptation are similar in all sugar factories, each situation presents its own individual problem, which is essentially one of piping equipment, which again in some cases may be double that of apparently equal situations.

There is perhaps no industrial plant in which more proper situations are offered for the use of steam traps of some kind than in the sugar factory. This is shown by the number in use aside from the known large number of condensation foci.

Often with both live and exhaust steam systems of the sugar factory there are many locations in which the quantity of condensation will not warrant the cost of its direct return into the boilers, especially when already equipped with regular boiler feed pumps. Again, there are situations in the live steam systems in which entrainment from the boilers is handled by steam traps, and such entrainment generally represents the worst impurities of the boiler water which should not be returned.

All of the above cover some of the fundamentals of steam trap service, which are proposed to be further analysed with descriptive cuts and detail of piping equipment as well as method of operation. Among the multitude of structural detail used in the numerous makes of steam traps it will be impossible, in a series of papers of this kind, to do other than select a few representative models and note their application to various sugar factory problems.

In the selection of types for illustrating methods of application and operation, those with which the writer is most familiar will naturally be used, and these of

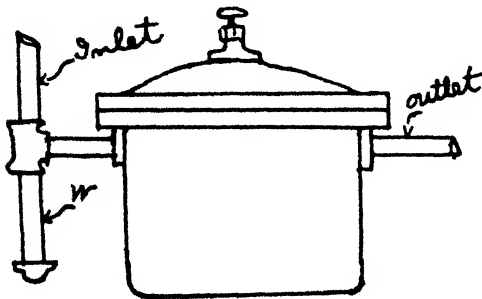


FIG. 1

American make; this in spite of considerable Cuban travel having shown a greater persistence of the European machine in its service than of the American make. This might equally mean much, little, or nothing. Also, all that applies to any machine of a given general class applies to all types of the same class, underlying principles of operation being the same for all.

What the slide valve, or its equivalent, is to the steam engine, so is the valve or valves to the steam trap: a vital. Using this as a guide it follows that first attention—constant for that matter, or may we say frequent?—is to be given to this item of steam trap anatomy. One of the most common troubles experienced with

valves handling water, especially those whose opening is not a fixed amount, but rather of the condition we call "wiredrawing," comes in the difficulties with foreign substances. These foreign substances consist largely of pipe chippings and occasionally of scale of various kinds. All of these may be destructive of valve integrity. The proper remedy, as in so many other cases, is prevention. The sketch in Fig. 1 represents a device of such simplicity, as a preventive, that it comes into the class that so many of us stumble past, because of its very simplicity. This same "scale pocket," as there shown, has a very wide application about the sugar factory. One of the greatest of these is the syrup pump for finished syrup from the multiple effect. With the sketch showing the trash-well at W, little or no explanation is needed.

Here again, after admitting the propriety of such scale prevention as a proper measure in all cases, here is the real situation so far as it affects non-return traps (quite differently from return traps). Any non-return trap may have its valve abraded or injured to any extent without real injury to service so long as the leakage thus occasioned be less than the minimum demand for valve opening. In this matter of valve equipment we may keep in mind that most generally all non-return steam traps have but one valve; the whole operation is directed toward securing a balanced opening of this valve to discharge the quantity of water demanded. Sometimes these machines have been found with what might be called twin valves, balancing each other, yet this does not alter the general duty of opening and closing a single valve.

All return steam traps necessarily have at least two water valves, one for the inlet and one for the outlet, moving alternately in their respective two directions of closing and opening.

Again, a further distinction between the return and non-return is the fact that the former is a consumer of steam and the latter not. All return steam traps are a displacement proposition, in that a volume of steam is required equal to that of the water handled. In reality there is a moderate excess of steam volume due to internal condensation in the trap chamber, which, however, is very slight. As shown later on even this steam may be utilized in the processes making the actual steam consumption only that radiated as heat from the machine. The non-return trap, as is easily seen, simply functions as an automatic release valve for water discharge, and if in proper operation does not let steam pass.

This brings to mind frequent accusations against non-return traps of "blowing steam" because a cloud of steam may practically always be seen at the discharge, when in the open. It has often been necessary to call attention to the fact that water passing the valve of a non-return trap, at temperatures above atmosphere, must expand, on release to the open, and generate steam to its equivalent excess heat, and may not have passed the valve as steam.

(To be continued.)

The Canadian authorities have recently imposed a tax on advertising matter, price lists and catalogues entering the Dominion, and arrangements have been made by which this tax can be prepaid by the sender by means of adhesive stamps to be affixed to the matter by the sender previous to mailing. Such Customs stamps can be procured in this country from the office of the High Commissioner for Canada, Victoria Street, London S.W. 1. There are two tariffs in force: the British one which varies from 1 cent. for 1½ oz. to 10 cents. for matter not exceeding 16 oz.; and the General tariff which range, from 1 cent. for 1 oz. to 16 cents for 16 oz. All kinds of purely advertising matter are included in this arrangement. The prepayment of the duty is of course optional; but it may be assumed that in practice it will be obligatory on the part of the sender if he is to be sure of his missive being accepted by the addressee.

The Pneumercator System of indicating the Exact Contents of Tanks.

The Pneumercator System has been designed primarily to provide means for the indication at a distant point or station of the quantity of liquid stored in a tank or other vessel. It is an interesting application of the pneumatic transmission of hydrostatic pressure due to a column of liquid to a distant observing station, whether the liquid column be the height of a tide, the level of a river or reservoir, the depth of valuable liquid in a storage tank employed in some industrial process, e.g., juice, syrup, molasses, etc.

The essential features of the normal apparatus are illustrated in Figs. 1, 2 and 3. The inverted hollow hemispherical vessel is fixed at or near the bottom of the

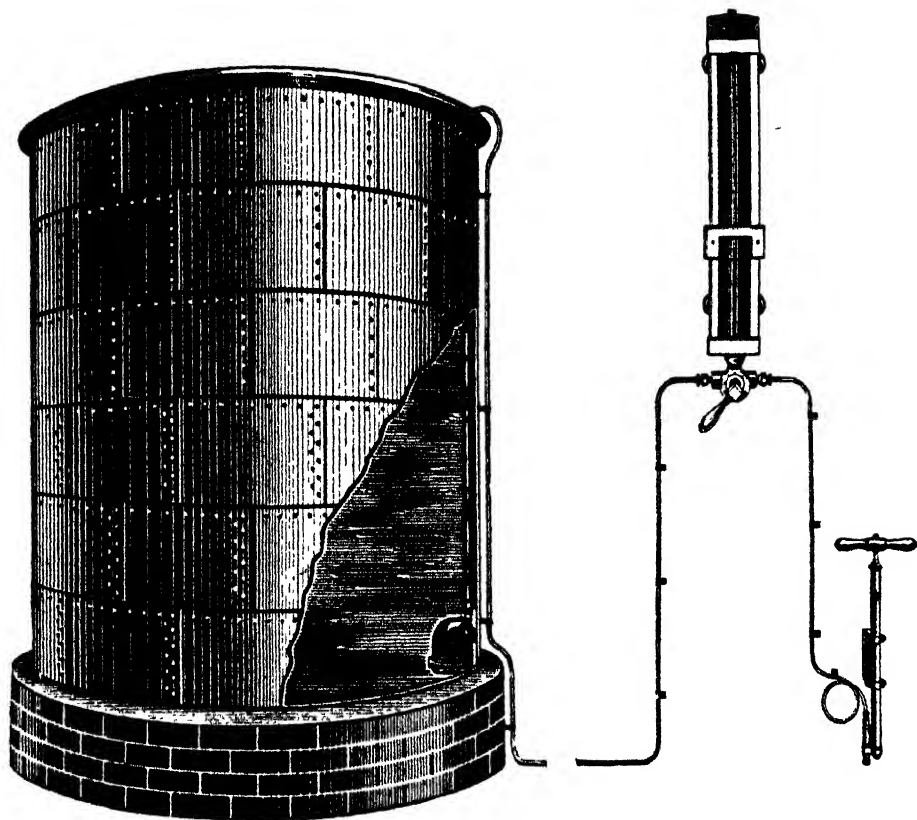


FIG. 1.

tank. In its side a sharp edge orifice is cut which forms the datum or zero line from which measurements are made. To this "balance chamber" as it is styled, a small air pipe is connected and led away to the distant indicating gauge. This Pneumercator gauge is a robust form of mercury column pressure indicator. Near the gauge is located a hand operated air pump connected up to the system by means of the control cock which is an important feature of the system.

The elements of the system are of extreme simplicity and the principle of operation is as follows:—Imagine the tank empty, and liquid to be pumped in; as soon as it covers the sharp edged orifice, air is trapped in the balance chamber.

As the level of liquid rises in the tank, the head of liquid above the orifice impresses a corresponding pressure on the imprisoned air, which pressure is transmitted by the small air tube to the mercury indicating gauge. (Fig. 2). The control cock allows of this pressure being applied to or cut off from the gauge, or again allows of the gauge being isolated and vented to atmosphere. It further

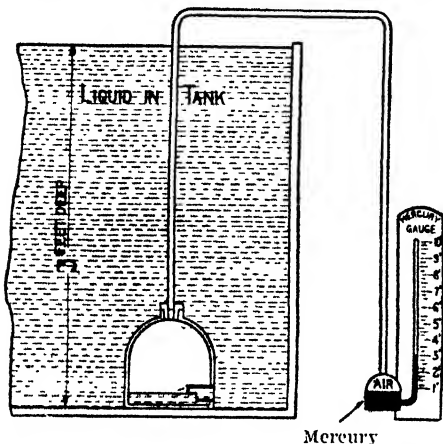


FIG. 2.—Trapped Air in Balance-Chamber Compressed by Head of Liquid in Tank.

allows of the air pump being connected directly to the balance chamber by way of the air piping. Since, as the head of liquid and consequently the pressure on the imprisoned air, is increased, its volume will decrease, liquid will enter the balance chamber and thus cause a false datum of measurement by raising the liquid level in the balance chamber slightly above the orifice or datum level. This is overcome by the provision of a simple hand air pump, which, used in conjunction with the gauge control cock, allows of air being pumped into the system so that the liquid in the balance

chamber is depressed to the sharp edged orifice and thus the datum of measurement is maintained. A few strokes of the pump are made before each reading, so that all readings are made with a perfectly definite datum of measurement. During its use any excess air pumped in freely bubbles out at the balance chamber orifice and does not affect the datum level. (Fig. 3). By means of the control valve, the air pumped into the system is deflected past the gauge, so that no air flows through or over the indicating mercury which would tend to oxidise the mercury and render it sluggish in the gauge indicating tube. The control valve is now turned to connect the balance chamber to the gauge so that the pneumatic pressure in the chamber due to the head of liquid above its orifice (and datum level) is transmitted through the air tubing to the mercury gauge and the mercury column rises to a height exactly equivalent to the head of liquid in the tank. By putting the control cock to "vent," the mercury chamber as well as the upper end of the indicating gauge tube are open to atmosphere and the mercury falls to the datum level zero on the gauge scale. Thus the gauge zero can be checked at any time.

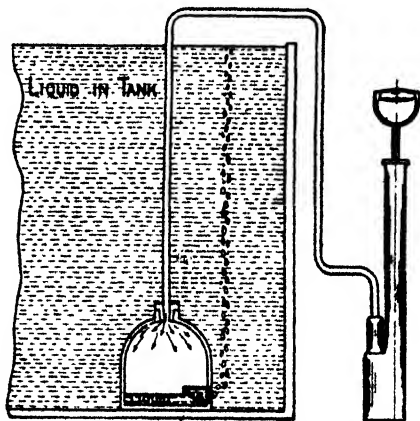


FIG. 3—Liquid in Balance-Chamber Restored to its Datum Line.

The operation of the air pump before taking a reading ensures the correct maintenance of the datum level in the balance chamber. If insufficient air has

The Pneumercator System of Indicating the Exact Contents of Tanks.

been pumped in, the fact is disclosed by repeating the operation, when a higher reading on the gauge will be obtained, thus, the gauge is self-checking.

Changes of temperature of the air-line system have no effect on the accuracy of the gauge. If, for example, the air line is heated up, the air in it expands and the excess volume bubbles out at the balance chamber orifice. If the air line is cooled and the air in it contracts, the tank liquid rises very slightly in the balance chamber, but when the air pump is operated for the next reading the air volume is restored and the datum level regained.

Since the transmitting medium is air only, the gauge may be above or below the tank or at any reasonable distance from it. It may be scaled not only to read depth, but also weight or volume of tank contents. The Pneumercator system permits of coupling one indicating gauge to a number of tanks where this is convenient, the gauge being connected with any one of the tanks as desired by means of "selector" valves operated at the observing station. It can be applied to tanks under internal pressure or vacuum, the internal pressure being compensated for by leading a second air tube from the tank top to the top of the gauge column, leaving the actual liquid head only to operate the mercury column.

When desired the gauge may be fitted with an annunciator, by means of which alarms and signals are given when pre-determined levels of liquid on the tanks are reached. The gauge mercury column brings this alarm gear into action, no wiring or contracts at or near the tank being required.

In many cases the control of stocks of liquid in process of manufacture, or by-products, as molasses, from the superintendent's office by having visual indications there of the quantities in the various distant tanks in circuit, has resulted in considerable benefit. Accurate knowledge at all times on the part of those in charge tends to detect leakages and promote efficient control.

Many tanks in factories carrying liquids used in manufacturing processes are difficult of access, and measurements provided by the Pneumercator system without necessity to visit the tanks and "sound" them have proved of the greatest value in the economical use of the liquids on the part of the employees.

Each Pneumercator outfit requires to be made up for the specific purpose for which it is to be used; and when inviting quotations it is necessary to supply the following particulars¹:—(1) Dimensions of the tank or tanks; (2) depth and cubic capacity per inch of depth; (3) distance from the tank to the indicating instrument; (4) and the nature and specific gravity of the liquid (juice, syrup, molasses, alcohol, etc.) to be measured.

As showing the efficiency of Rees Roturbo pumps, it may be mentioned that at a recent fire in a Calcutta suburb, a Leyland-Roturbo fire engine made what is believed to be a record in fire pumping. It ran continuously for 37 hours and pumped about two million gallons of water.

According to the Bulletin of the Czecho-Slovak Ministry of Agriculture, quoted in the *Times*, 259,323 tons of sugar were exported during the year ended September, 1920, as compared with 282,899 tons exported during the corresponding period in the previous year. The most extensive purchases were made by the following countries:—

	Tons.		Tons
France	132,282	Bulgaria	8,909
Austria	35,718	Yugoslavia	7,185
Germany	33,740	Poland	6,802
Norway	15,433	United States	2,941
Italy	9,965		

¹ Agents for the cane sugar industry (excepting in U.S. and her territories): THE SUGAR MANUFACTURERS' SUPPLY CO., LTD., 2, St. Dunstan's Hill, London, E.C.3. (See advert.)

Data concerning the Advantages, Production, and Cost of "Natilite" Motor Fuel.

III.

DENATURING ALCOHOL IN GENERAL.

Alcohol is now very largely employed in most countries in many manufacturing operations, as well as a source of light, heat and power. When so used, it is seldom that any duty is imposed on it; but then it must be "denatured," that is, mixed with a nauseous substance, or mixture of substances, in order to render it unfit for drinking purposes.

Before passing to the denaturing of "Natilite," it is worth while briefly considering the question of the denaturing of alcohol in a general way. The qualities that a satisfactory denaturant should possess are the following:

(1) It should impart a taste or smell sufficiently disagreeable to prevent the alcohol from being drunk, even after dilution, sweetening or flavouring. (2) It should not be capable of being easily eliminated, by filtration, distillation, or other readily applied process. (3) It should be capable of being easily and certainly detected. (4) It should mix readily with the spirit without altering its properties when used as a fuel. And (5) its addition should not materially add to the cost of the denatured alcohol.

Several substances have been found to fulfil one or more of these conditions; but no single product has yet been brought forward which meets all five fully. Wood naphtha, or crude methyl alcohol, is the denaturing agent most largely used in every country using industrial spirit on a large scale; but, as Sir JAMES DOBBIE¹ recently pointed out, this material only partly fulfils the first condition, since even the addition of 10 per cent. does not prevent the methylated spirit from being drunk by some abnormal individuals. Generally speaking, wood naphtha meets the second condition, though not entirely, as will be pointed out later. In general, this denaturant also meets the third condition; but in regard to the fourth, and to the fifth and last and by no means the least condition, the position is not so satisfactory. As a simple computation based on current market prices will show, the addition of this denaturant certainly adds to the cost of the alcohol; while pyridine which is also adopted for the object under discussion is likewise an expensive substance to use.*

In order to obtain an insight into the state of this important problem of denatured alcohol, a short review of the conditions prevailing in the principal countries of the world may be made.

Denaturing in the United Kingdom.—Great Britain in 1855 sanctioned the use for industrial purposes of a mixture of ordinary alcohol with 10 per cent. of wood naphtha, this mixture being termed "methylated spirits." In 1891 a "mineralized" spirit with an addition of 0.385 per cent. of mineral naphtha (that is, light mineral oil, having a sp. gr. of about 0.810 to 0.820) was brought into use for domestic and general requirements.² Later in 1906 the ordinary methylated spirit for use in industrial operations was cheapened by reducing the proportion of the wood naphtha to 5 per cent. At the present time, a certain limited quantity of alcohol is authorized for use in some manufactures after being

¹ See *I.S.J.*, 1920, 654.

² *I.S.J.*, 1919, 519, where it is pointed out that the production of "Natilite" in Natal was at that time rather seriously hampered owing to the high cost and the high import duty on wood naphtha and pyridine. Fortunately, this difficulty has been overcome, as the Government has now sanctioned the addition of Simonsen's Oil, an efficient and cheap material.

³ Since June, 1918, this mineralized spirit has been coloured by the addition of a little methyl violet dye.

Data concerning the Advantages, etc., of "Natilite" Motor Fuel.

specially denatured in a manner appropriate to the particular industry (e.g., that of dyestuffs, celluloid, fine chemicals, explosives); and in some few purposes, for which a noxious addition would prove unsuitable or detrimental, the spirit may be employed duty free in a pure state under stringent supervision.

Denaturing in America.—It was only in 1906-7 that the U.S. Congress sanctioned the duty-free use of industrial alcohol; and now a "completely denatured" and "specially denatured" alcohol is found in that country. Under the first heading, there are two formulæ, 100 gall. of the alcohol being mixed with 10 gall. of wood spirit and $\frac{1}{2}$ gall. of benzine in the first; and with 2 gall. of wood spirit and $\frac{1}{2}$ gall. of pyridine bases in the second. Under the heading of "specially denatured" alcohol, there are a number of formulæ which are sanctioned for use in special industries, in which the alcohol may be mixed with wood spirit, pure methyl alcohol, castor oil, soda-lye, nicotine, benzol, acetone, or various salts and dyes. In Canada, the methylated spirits contains a higher proportion of wood spirit than in any other country, namely 25-50 per cent.

Denaturing on the Continent.—Germany was early alive to the importance of encouraging the use of alcohol in the arts and manufactures; and in that country also denaturing is designated as "complete" or "incomplete." The general substance in use is 4 parts of wood naphtha and 1 of pyridine bases to each litre of which 50 grms. of lavender or rosemary oil may be added to mask the smell of the pyridine. Two and a half litres of this mixture are added to every hectolitre of alcohol. Alcohol for motor fuel is "completely" denatured by the addition of $1\frac{1}{2}$ litres of the general mixture and $\frac{1}{4}$ litre of a solution of methyl violet dye, together with 2 to 20 litres of benzol to every 100 litres of alcohol. There are also a number of special formulæ for use in various manufacturing operations, which need not be mentioned here.

In France the general denaturant is again wood spirit of a concentration not less than 90° containing 25 per cent. of acetone with 2.5 per cent. of pyroligneous impurities, 10 litres of this mixture being used per 100 litres of the alcohol to be denatured. As in other countries, there are also specially authorized mixtures which may be used in certain processes.

DENATURING "NATILITE."

Coming now particularly to consider "Natilite," it may be remarked that the alcohol, ether, and ammonia combine to form a mixture which, even without the addition of any other substance, is practically undrinkable, the ammonia alone serving as an efficient denaturant. In the United Kingdom, however, the authorities have stated that the denaturing operation required in the case of "Natilite" (the first consignment of which will have reached this country by the time these lines are in print) must be conducted as follows:

"by mixing the "Natilite" with wood naphtha, crude pyridine, and benzol, in the proportion of $2\frac{1}{4}$, 0.5, and 5 per cent. respectively of the volume of "Natilite." There must be added to every 100 gallons of the mixture one-twentieth of an ounce of methyl orange aniline dye."

It may be remarked that it is much to be regretted that the employment of naphtha is still insisted upon by the home authorities as an addition to such a mixture as "Natilite." Presumably this denaturant is prescribed because it was one of the first employed. Not only is it expensive (to which disadvantage Sir JAMES DOBBIE has himself alluded¹); but it also depreciates the quality of the mixture to which it is added in respect to its use as a fuel for internal combustion engines.

¹ *Loc. cit.*

Another disadvantage that may be mentioned here in regard to wood naphtha is that under certain conditions it can be separated from alcohol sufficiently to yield a comparatively drinkable product, a fact known to every chemist. Special apparatus would, however, be necessary.

At this point attention may be directed to a new denaturant that has given very satisfactory results from the points of view of economy and efficiency. In 1913, EINAR SIMONSEN, chief inspector of Breweries and Distilleries, Norway, after careful investigation introduced "a new improved method of denaturalizing spirit," which he has patented in different countries.¹ In describing the considerations leading up to his invention, Mr. SIMONSEN has pointed out that petroleum is known to form a remarkably good denaturing agent. It is cheap; it has an abominable taste; and it does not affect the quality of the alcohol to which it is added as a motor fuel. The higher fractions (i.e., those boiling between 150 and 300° C.) cannot be used, for the simple reason that they are insoluble in spirit; while the lighter portions,



FIG. 1.—Native bagging Sago for Food *

the so-called benzines, have an insufficiently denaturing effect, though they are soluble enough in the spirit. Mr. SIMONSEN was led to try the use of crude petroleum, that is the raw product before being submitted to distillation; and found that it was soluble in concentrated alcohol (the benzines holding the heavier oils in solution), and also that it had a satisfactory denaturing effect. However, it proved to have a distinct disadvantage, namely that after a time the asphaltic constituents separated out, changing the alcohol into a somewhat thick and dirty liquid.

Mr. Simonsen's invention consists, therefore, in using petroleum which has been separated from this objectionable asphaltic portion by the simple operation of distillation, using the fraction coming over below 300° C. Alcohol treated with only $\frac{1}{2}$ per cent. of this distillate possesses an abominable taste. It has not a particularly bad smell until diluted with water when the objectionable odour becomes apparent, the liquid at the same time becoming milky. In this dilute state, the "oil" cannot be separated, either by subsiding, by filtering, or by distilling. The reason why this denaturant cannot be separated by distillation from alcohol containing it, of course, is that it contains constituents that come over in the distil-

¹ German Patent, 285,190.

Data concerning the Advantages, etc., of "Natilite" Motor Fuel.

late at any temperature from 50° upwards. Experiments are stated to have shown that it is impossible to separate the oil from the denaturated spirit even by a preliminary treatment with char. Another fact in favour of its use is that, granted the disgust of an individual to alcohol containing Simonsen's oil to be somehow overcome, the physiological effect of the first mouthful is to close the pharynx (probably by a kind of reflex action), so that any further attempt to drink becomes abortive for the time being.

It is interesting to note that this cheap and efficient denaturant has now been accepted by the Governments of Australia, South Africa, Portuguese East Africa, and British India as a suitable denaturing agent for "Natilite." It is likely that the adoption of such a material will soon follow in other countries as well.



FIG 2.—Character of Sago Palm Country.*

"NATILITE" DEVELOPMENTS IN AUSTRALIA.

In our previous contribution when dealing with the question of raw material,¹ it was pointed out that in certain countries the molasses available may be insufficient for the supply of the total amount of "Natilite" required. Further, under certain conditions, the cost of collection of the molasses from outlying districts may raise its cost to an insufficiently profitable figure. It has been decided by the Natilite Motor Spirit Co. of Australia, Ltd., that although the molasses of Queensland may be conveniently used for the production of alcohol, other sources of raw material should be considered.

Some short time ago, therefore, following upon consultations with Mr. H. G. A. HARDING, F.C.S., a well-known chemical technologist of Sydney, an expedition was despatched under his supervision to the wilds of New Guinea in search of suitable raw material for the manufacture of the fuel. Mr. HARDING took a complete laboratory equipment with him for testing purposes; and after traversing the most promising parts of the territory finally selected an area in the Western district near the Paibuna and Turama Rivers, as supplying very suitable material in very satisfactory quantity. The material was principally the native sago palm, of which there is a very luxuriant growth in the area selected. These trees grow

¹ *I.S.J.*, 1921, 213.

* Photographs of wild Sago Palm country in New Guinea, as surveyed by Mr. H. G. A. HARDING, F.C.S., expert to the Natilite Co.

to a height of 50-60 ft., and in many instances have a gross weight up to two tons. An area of 100 square miles of the most suitable land was marked out by Mr. HARDING, and granted to the Australian Natilite Co. for its operations. Mr. HARDING has outlined a plan by which there is immediately available a sufficient amount of raw material to produce 6,000,000 gallons of "Natilite" per annum, a total yield up to 18,000,000 gallons being later obtainable from the same land in an inexhaustible manner. This would be done by dividing the land into regular sections, some to be used annually while others are under cultivation.

Arrangements have now been also made for the erection of a plant during the next 12 months at a suitable location in New Guinea of a capacity of 6000 gallons per day. In harvesting the material, the trees will be cut, sawn into logs, and the outside bark split off by suitable mechanical means. A pith which is essentially starch with varying amounts of fibre and moisture is thus obtained. Calculating on the washed and dried material, it is estimated that the yield from this pith should be 73 gallons of absolute alcohol per ton, a very satisfactory figure.

In order to convert the starch into fermentable sugars, instead of the malting process it has been decided to use a culture of bacteria for liquefying the starchy matter, a culture of fungi for converting the liquefied starch into sugar, and a special culture of yeast for the fermentation of alcohol. It is estimated that by working in this way, there will be a saving of 35-40 tons of malt per week on the initial output, a remarkable economy, besides allowing for a little greater efficiency in the higher yield.

"Natilite" thus manufactured will be shipped by the Company's boat or boats containing suitable tanking accommodation to Sydney, the proposed head distributing station. Standing orders for "Natilite" in Australia are already in hand to approximately cover the present anticipated output. Considering the high cost of petrol in the Commonwealth now, nearly 5s. per gall., the numerous advantages of the new fuel, besides its low cost of production, the outlook for "Natilite" is a bright one. In Australia its advent is being heralded with delight by the average motorist. Mr. HARDING has also mapped out a large area of sago palm for the Natilite Motor Spirit Co. of Great Britain, and has now in hand the designing of portable works and plant for a very large output.

In the subsequent article, it is proposed to give a description of the distillation and rectifying plant installed in one of the "Natilite" factories.

(To be continued.)

It is reported that the Taikoo Sugar Refining Co., Quarry Bay, Hong Kong, are re-building their refinery to work about 6000 tons per week. The contract was secured by an English engineering firm.

During 1917-18, Prof. HERZFELD, at the Institute für Zuckerindustrie, carried out experiments on the production of inulin and levulose, chicory roots being sliced and extracted following very much the same process as that used in the beet sugar factory. A good caramel or sugar colouring in powder form, which had a high tinctorial value, was also made from the levulose.

Louisiana houses in 1919-20 received some 70,000 tons of raw sugar from different sources, which they worked up into white granulated. The average yield is given as 88 lbs. of firsts and 4 lbs. of seconds per 100 lbs. of the raw sugar melted, some factories obtaining more, and others much less.¹ Bone-black refineries in America get 93 lbs. of granulated from every 100 lbs. of raws.

¹ See also *I.S.J.*, 1921, 221-229.

Problem of the Decomposition of Sucrose during Milling.¹

By J. N. S. WILLIAMS.

This paper is written with the express purpose of exciting a discussion on the subject of losses of sugar in process of manufacture.

Many factories now use shredders and other machines to prepare the cane for milling. They grind with three sets of rollers to seven sets of rollers; and apply compound maceration, whereby juices from the following mills are pumped back and used to saturate the bagasse issuing from the leading mills. Wash water from the filter-presses is very generally used in maceration, being in many instances mingled with the thin juices from the last crushing and pumped back for saturation purposes either in front or behind the first mill. Condensation water from the second, third, and fourth bodies of the evaporators is also used for this purpose.

The question arises whether decomposition and loss of sucrose take place during the multiple crushing of cane when accompanied by compound maceration combined with the use of filter-press wash-water or condensation water from the evaporators.

The conditions which favour the supposition that decomposition does actually occur are as follows:—Cane, in the first instance, is torn to shreds in preparation for milling, and large surfaces of juice-bearing tissue are exposed to the oxidizing influence of the atmosphere. Repeated crushing under the heaviest possible pressure ruptures all the cells in the cane tissue and releases quantities of deleterious matter, amongst which substances favourable to a rapid chemical action on the resulting juices are undoubtedly present. This extraction of deleterious matter is undoubtedly accentuated by the use of the filter-press wash-water containing some sucrose and soluble impurities which make this wash-water of a very low purity; and this liquid, if in the slightest degree acid, would certainly have detrimental effects upon the juices of the fresh canes being ground.

Canes having been cut and allowed to remain unground, in time deteriorate, and while it is not known for certain what changes take place in the juice of such canes, it is known that these juices turn sour rapidly, with increasing acidity between the time the juices leave the mills, pass through the weighing scales and are lined, before being pumped through juice heaters.

There is no doubt whatever that using the thin juices from the last mill for maceration purposes where such cane is ground, is detrimental to the juices as a whole. Numerous instances can be presented, especially in connexion with the grinding of drought-smitten or overripe canes, where these conditions occur.

From the foregoing considerations it would seem to be clear that a certain amount of decomposition of sucrose does take place during the operation of milling, and while this may be negligible in some instances, it may be a matter for serious consideration in others.

It is well known that juice extracted from cane by the diffusion process in closed vessels under pressure, and therefore free from atmospheric influence, has a quotient of purity of only about one-half a point lower than juice corresponding to the first mill juice in an ordinary train of mills, while juices resulting from multiple crushing and compound maceration have purities varying from two to four points lower.

¹ Report presented to the Committee on the Manufacture of Sugar and Utilization of By-Products, appointed by the Hawaiian Sugar Planters' Association, September, 1920.

It has been observed that the calculated normal juice of any cane crushed in mills which do not extract more than 91 to 92 per cent. of sucrose is, by analysis, higher in sucrose and purity than the calculated normal juice from similar canes which have been crushed in more powerful mills, and show an extraction of 96 per cent. or more.

The sucrose in cane being calculated on the sucrose in mixed juice plus the sucrose remaining in the bagasse, is lower in canes subjected to extremes of crushing and compound maceration than in canes of equal quality (as far as the analysis shows) which are not subjected to such heavy pressures and consequently do not obtain such a high degree of extraction.

The following are concrete examples taken from crop results 1919-1920 :—

Plantation A, extraction.. ..	89.1 per cent.	Fibre	13.3 per cent.
First mill juice	16.6 polarization.	88.3	purity.
Calculated normal juice	16.1	86.5	„
Pure sugar in cane, 279.4 lbs. per ton.			
Plantation B, extraction.. ..	96.34 per cent.	Fibre	13.76 per cent.
First mill juice	17.50 polarization.	87.55	purity.
Calculated normal juice	15.55	83.06	„
Pure sugar in cane, 268.21 lbs. per ton.			
Plantation AA, extraction	92.58 per cent.	Fibre	13.25 per cent.
First mill juice	16.65 polarization.	87.13	purity.
Calculated normal juice	15.36	83.61	„
Pure sugar in cane, 266.4 lbs. per ton.			
Plantation BB, extraction	98.7 per cent.	Fibre	10.85 per cent.
First mill juice	16.84 polarization.	84.9	purity.
Calculated normal juice	12.95	81.9	„
Pure sugar in cane, 256.8 lbs. per ton.			

From these figures it will be observed that Plantation A, showing an extraction of 89.1 per cent. and having a fibre of 13.3 per cent. and producing a first mill juice of 16.6 polarization and 88.3 purity, has per ton of cane in pure sugar 279.4 lbs. Plantation B, which shows an extraction of 96.34 per cent. from cane containing 13.76 per cent. fibre, and producing a first mill juice having a polarization of 17.50 per cent. and purity of 87.55 per cent., has per ton of cane 268.2 lbs. of pure sugar, a difference of over 11 lbs. of pure sugar per ton. The same results are shown in Plantation AA and Plantation BB in the above figures, and such instances can be multiplied.

If there had been no destruction of sugar in the process of milling, why is it that Plantation A, dealing with cane not nearly so good as Plantation B, is charged with 279.4 lbs. of pure sugar in cane when Plantation B is only charged with 268.2 lbs.? Can this difference be accounted for? And if it cannot, is it not a fair inference that sucrose has been destroyed? The argument against this theory of destruction of sucrose during compound maceration may possibly be deduced from the reported results of manufacture. Some few factories report total losses, including final molasses, less than 10 per cent. of the sucrose reported in the cane.

Any argument based upon the reported losses will not, however, dispose of the question above propounded, because if there are losses in the process of milling, the present system of determining the sucrose in the cane cannot disclose them. So it would appear that this matter is worth discussing, and that, if the answer to the question put is in the affirmative, further discussion as to what should be done might profitably be entered upon.

Cost of Production of Sugar in Mauritius.¹

By HENRI ROBERT.

Statistician, Department of Agriculture, Mauritius.

This paper should be regarded as a preliminary contribution to the study of the cost of the production of sugar in the Colony. In order to ascertain as accurately as possible the average cost of placing 50 kg. of sugar on the market, the figures of nearly 30 usines have been examined, that is, more than half the total number. It may be regarded as certain that data from the omitted factories would not have appreciably influenced the results, since the factories selected represent all grades.

It must, however, be understood that while the table constitutes a comprehensive index to the vicissitudes of the sugar industry during the final five pre-war years, and to the violent changes in costs and prices brought about by the war, it does not give the absolutely exact cost of production, nor the absolutely exact net profit of the whole sugar industry of the Colony. It is difficult to state accurately what has been called "the elusive cost of one ton of sugar cane or beet." After investigating the problem of the average cost of producing one ton of sugar, the statistician has then to reconcile the conflicting figures of the cost of cane cultivation supplied by the growers, due to the varying degree of fertility of the land, the methods of cultivation, the vicissitudes of climate and other accidental factors, local conditions of labour, distance from the factory, etc. In Mauritius, such difficulties are accentuated by the considerable proportion of Indian-owned cane cultivation.

Notes on the Table.—"Sale of Sugar" means the total earnings after deduction of all such charges as commission, discount, brokerage, rent, weighing, etc., and also lighterage and export duty when sold f.o.b.; that is to say, the figure is the net sale price. By "Sundries" are understood estates' petty receipts or realizations, such as rent of shops, sale of old machinery, etc. By "*Faisance valoir*" is meant the operating costs or ordinary working expenses, including the growing, cutting and transport of estates' canes, as well as the purchase of planters' canes, the upkeep of factories, manufacturing costs, hospital charges, insurance, transport of sugar to the docks, etc.; but not allowing for depreciation. Under "Other charges" have been grouped such overhead charges as interest on *faisance valoir*, on the cost of purchased canes, on mortgages, etc., incidental expenses, town office expenses, legal advisers' fees, discount and such like charges, but not including subscriptions to Charity or War Funds, nor gratifications to managers and employés, nor gifts of sugar, etc. Under "Capital charges" have been put together all expenditure for new installations, as well as redemption of debts for machinery, etc., tram lines, liquidation of mortgages, Government loans and similar encumbrances.

Interpretation of the Figures.—The fluctuations of the "Capital charges" column of the table are noticeable, and constitute a measure of the extent to which planters have availed themselves of remunerative crops to make new installations or to pay off their debts. No doubt, the figures for the war period would have been much higher had it been possible to receive new machinery from England.

¹ Extracted from Bulletin No. 5, Statistical Series, published by the Department of Agriculture, Réduit, Mauritius, 1920.

(NORMAL RATE OF EXCHANGE: £1 = 15 RUPEES.)

Year.	Total Sugar Output in Metric Tons.	Total Receipts (Sale of Sugar and Sundries).		Total Expenditure.		Net Profit or Loss.		Expenditure Detailed.						Receipts per 50 kg. of Sugar made.		Expenditure per 50 kg. of Sugar made.				Net Profit.	Margin between Sale Price and Purchase Value.								
								Purchase Value.			Capital Charges.					Average Sale Price.			Total with Sundry.			Purchase Value.		Other Charges.		Capital Charges.		Total.	
Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.							
1909	252,000	43,372,194	33,745,794	9,626,400	25,250,400	2,850,594	5,644,800	8-46	8-61	5-01	0-57	1-12	6-70	1-91	3-45	1-91	3-45												
1910	282,830	32,225,675	32,399,682	174,007	26,427,638	2,183,934	3,788,110	7-10	7-23	5-93	0-49	0-85	7-27	0-04	1-17	0-04	1-17												
1911	169,650	33,299,620	32,655,330	644,290	27,229,730	2,644,980	2,780,620	9-69	9-82	8-03	0-78	0-82	9-63	0-19	1-66	0-19	1-66												
1912	213,060	31,575,402	30,765,864	809,628	25,865,484	2,258,436	2,641,944	7-23	7-41	6-07	0-53	0-62	7-22	0-19	1-16	0-19	1-16												
1913	249,700	35,407,460	33,110,220	2,297,240	28,366,920	2,347,180	2,397,120	6-93	7-09	5-68	0-47	0-48	6-63	0-46	1-25	0-46	1-25												
	1,107,140	175,880,441	162,676,890	13,203,551	133,139,172	12,285,124	17,252,594	7-79	7-94	6-01	0-56	0-78	7-35	0-59	1-78	0-59	1-78												
1914	277,360	63,681,856	48,149,696	15,532,160	36,278,688	2,496,240	9,374,768	11-33	11-48	6-54	0-45	1-69	8-68	2-80	4-79	2-80	4-79												
1915	214,520	51,184,472	40,544,280	10,640,192	32,521,232	2,273,912	5,749,136	11-78	11-93	7-58	0-53	1-34	9-45	2-48	4-20	2-48	4-20												
1916	209,035	52,718,627	45,193,367	7,525,260	37,459,072	2,173,964	5,560,331	12-42	12-61	8-96	0-52	1-33	10-81	1-80	3-46	1-80	3-46												
1917	225,965	52,243,108	45,644,930	6,598,178	40,673,700	2,440,422	5,530,808	11-38	11-56	9-00	0-54	0-56	10-10	1-46	2-38	1-46	2-38												
1918	252,772	62,535,793	53,940,435	8,696,358	47,824,462	2,173,839	3,842,134	12-20	12-37	9-46	0-43	0-76	10-66	1-72	2-74	1-72	2-74												
	1,179,652	282,363,856	243,372,708	43,991,148	194,757,154	11,558,377	27,057,177	11-80	11-97	8-25½	0-49	1-14½	9-89	2-08	3-54½	2-08	3-54½												
Averages:—																													
1909-13	221,428	35,176,089	32,535,378	2,640,711	26,627,834	2,457,025	3,450,519	7-79	7-94	6-01	0-56	0-78	7-35	0-59	1-78	0-59	1-78												
1914-18	235,930	56,472,771	46,674,542	9,798,229	38,961,431	2,311,676	6,411,435	11-80	11-97	8-25½	0-49	1-14½	9-89	2-08	3-54½	2-08	3-54½												

Note.—It should be pointed out that the total profit of the whole cane industry is greater than that shown in the penultimate column, inasmuch as a considerable proportion of the canes handled are purchased from small planters and estates without a usine. The purchase price paid for these canes is included in the column *fauxcane valeur*, which therefore includes the profit realized by the outside cane grower. It is estimated that if a deduction is made for this, the total profits realized by the cane industry taken as a whole will require to be increased in the mean by 8 to 12 per cent.

Cost of Production of Sugar in Mauritius.

One will also notice that, compared with 1909 (the most profitable year in the first quinquennial period) the crops of 1917 and 1918 show a smaller margin of profit between sale price and *faisance valoir*, although the average sale price in 1909 was only Rs. 8.46, against Rs. 11.38 in 1917, and Rs. 12.20 in 1918. This indicates the effect of the rapid increase in the cost of production since 1916.

If the annual average profits of the pre-war period 1909-1913 are reviewed, it will be seen that, save in 1909, they were critically narrow. In fact, though many favourably situated estates were still giving very fair profits, the majority were hovering round the danger point and were near the no-profit line.

It is clearly shown by the *faisance valoir* column that the efforts of planters to diminish their cost of production were gradually counterbalanced by other factors, e.g. the increasing cost of labour and material. For instance, in the case of the 1910 crop, which crop was nearly 12 per cent. smaller than that of 1909, the *faisance valoir* should have been normally less than that of the latter year, even if we take into consideration the extension of cultivation on estates, since the 1909 crop entailed considerable additional transport and other crop expenditure. The cost of labour, which was already rising in 1909, was however further increased in 1910 through various causes (notably the marked increase in Indian cane cultivation resulting from the rise in the price of sugar in 1909) and augmented the cost of production.

The 1911 crop shows a still more striking advance in the cost. As a matter of fact the *faisance valoir* of even so poor a crop was so high that planters made every endeavour to lower their expenses, economizing on every possible item in order to escape insolvency. The 1912 *faisance valoir* was thus considerably lowered, in spite of the higher cost of rice and other grains, and of the ever-increasing price of labour and of materials. Even so, however, the margin of profit remained very narrow on account of the falling off of the sugar sale price. The same rigid policy of economy ruled in 1913, but planters' efforts were counterbalanced by a further sharp rise in the price of grains and by the constant upward trend of wages; the price of sugar having declined (average Rs. 6.93), their margin of profit on a relatively big crop (the best then after 1909) was very small.

Influence of the War.—Had it not been for the effect of the war, the position would doubtless have been critical in 1914, as critical in fact as in 1907 and 1908, in spite of the record crop of canes then on the land, bearing in mind that the rising cost of labour, of rice, etc., was operating with ever-increasing stringency, while sale prospects were so sombre that first-class sugar had been sold in July, 1914, at Rs. 8 per 50 kgs. If this price had been maintained the average would have been below that of 1913, the actual average sale price recorded was, however, Rs. 11.33, the difference being entirely due to war conditions.

The serious position in which the Mauritius planters would have found themselves in 1914 had it not been for the war, would have been reflected elsewhere, since, it the opinion of the U.S. Tariff Commission, "had normal times continued, and had the import duty on all sugars been removed in America, as contemplated, only about 43 per cent. of the production in Porto Rico, 48 per cent. in Hawaii, and little or none in Louisiana, would have survived under free trade in the United States market."

Unfortunately no great improvements to the usines have been possible since the beginning of the great wave of prosperity, as practically no machinery could be imported from abroad, otherwise a not inconsiderable part of the Rs. 105,865,000 surplus receipts made during the five years 1914-1918 as compared with the five

previous years, would have been applied under the stimulus of progress and competition to the modernization of factories. It is no exaggeration to assume an average of Rs. 300,000 per usine as the amount necessary for the modernization of factories in Mauritius. This represents at least Rs. 15,000,000, *i.e.*, fully one third of their aggregate value, calculated on the pre-war standard of Rs. 80,000 per million pound sugar manufacturing capacity.

A Few Observations upon the Neutral Polarization Modification of the Clerget Method.

By C. A. BROWNE.

In a recent paper¹ entitled "The Application of the Clerget Method to dilute Sucrose Solutions," R. F. JACKSON and C. L. GILLIS reply to a criticism² which the writer recently advanced against the principle of the modification known as the method of neutral Clerget polarization. They show by determinations of known amounts of pure sucrose in dilute solutions that the tables of their Bulletin 375³ give accurate results, and hence conclude that their modified method is capable of indicating the sucrose content of a mixture with a high order of accuracy.

Dr. JACKSON and Miss GILLIS in their reply bring up several points that admittedly were not touched upon by the writer in his preliminary communication, his purpose there being simply to state what he considered to be a fundamental error in the general principle of the method of neutral polarization as applied to the analysis of complex mixtures, the real purpose of the method under consideration. That it is possible to use the neutral modification of the Clerget method for the accurate determination of sucrose alone, no one will deny, and the experiments of Dr. JACKSON and Miss GILLIS to demonstrate this are irrelevant to the main issue which the writer had in mind. The accuracy of their own formulas and tables in so far as the analysis of sucrose solutions is concerned is an entirely different question which the writer did not touch upon in his previous paper. But as this question also has a certain bearing upon the general principle of neutral polarization, in the present paper a few of the formulas and methods described in Bureau of Standards Scientific Paper No. 375 will be discussed.

Explicit directions for calculating the positive constituent of the Clerget divisor are given by JACKSON and GILLIS on pages 175-177 of their Bulletin.⁴ The value of the positive constituent in the case of ammonium chloride for example is given as $100 - 0.169 m$ in which m represents the grms. of NH_4Cl in 100 c.c. of solution. The value for the 3.392 grms. of NH_4Cl used in Method II (pages 184-5)⁵ would be $100 - (0.169 \times 3.392) = +99.43$, this positive constituent entering at the head of their table of divisors and being used in the calculation of all factors in that table.

It was shown by the writer in his previous paper that different weights of sucrose in presence of 3.392 grms. of NH_4Cl in 100 c.c. of aqueous solution do not give a constant polarizing power of +99.43, for the reason that though the weight of salt and volume of solution be always constant, the ratio between salt and water for the different weights of sugar changes. For a constant weight of salt in 100 c.c. of solution, the polarizing power of the sugar is found to vary

¹ *I.S.J.*, 1921, 217.

² *I.S.J.*, 1921, 168.

³ *I.S.J.*, 1920, 509, 570, and 638.

⁴ See *I.S.J.*, 1920, 573.

⁵ *I.S.J.*, 1920, 640.

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according to the water content. This may be shown by the following examples where 5 grms. of NaCl and different weights of sugar were dissolved in water to 100 c.c.

Table I.

(Showing variation of polarizing power of sucrose in presence of salt and water in 100 c.c. solutions.)

A		B		C		D		E	
NaCl. Grms.		Sucrose. Grms.		Water (W). Grms.		Polarization (P) in terms of 26 grms. sucrose, in 200 mm. tube.		Polarization calculated by formula $98.44 + 0.026 W - P$.	
5	..	52	..	65.5	..	98.14	..	98.14	
5	..	39	..	73.8	..	98.42	..	98.36	
5	..	26	..	82.0	..	98.58	..	98.57	
5	..	13	..	90.1	..	98.83	..	98.78	

The results in columns *D* and *E* show that the effect of a salt upon the rotation of sucrose is not alone a function of the concentration of salt, but that it is also a function of the amount of water per unit of volume. Conversely we may say that if the same ratio exists between salt and water, the polarizing power of sucrose for different dissolved amounts is constant. This is shown by the following experiments where different weights of sucrose were dissolved in a solution containing 10 grms. of NaCl in 100 c.c.

Table II.

(Showing constancy of polarization of sucrose in 10 per cent. solutions of sodium chloride.)

A	B		C		D		E	
Per cent sucrose.	Specific Gravity of Solution		Polarization for 200 mm. tube.		Polarization calculated to 26 grms. of Solution.		Ratio $\frac{D}{A}$	
6.2499	..	1.09065	..	25.55	..	6.09	..	0.9745
11.7646	..	1.11158	..	49.00	..	11.46	..	0.9742
21.0309	..	1.14823	..	90.55	..	20.50	..	0.9741
28.5722	..	1.17968	..	126.30	..	27.84	..	0.9742
34.7826	..	1.20623	..	157.10	..	33.86	..	0.9736
40.0000	..	1.22916	..	184.10	..	38.94	..	0.9736

These results show that for a 10 per cent. salt solution the polarizing power of sucrose in concentrations between 6 and 40 per cent. is depressed from 1 to a practically constant value of 0.974. The conclusions of Tables I and II simply confirm what has previously been noted by MUNTZ, FARNSTEINER, and other observers,¹ so that the experiments mentioned by the writer in his previous paper to disprove the assumption of JACKSON and GILLIS, that different weights of sucrose in 100 c.c. of a solution containing a constant weight of salt have a constant polarizing power, are fully verified. The extent of the deviation from the fixed value of + 99.43 for different weights of sucrose in 100 c.c. of solution are indicated in column *C* of the table given in his previous paper. These measurements represent the average readings of four observers upon two different saccharimeters. The results follow the general equation of $99.74 - 0.013 g. = p$, in which *g* represents the grms. of sucrose in the 100 c.c. of solution containing 3.392 grms. of NH_4Cl , and *p* the relative polarizing power or positive constituent. The observed and calculated values of the positive constituent as thus obtained for different weights of sucrose are:—

	52 grms.	26 grms.	20 grms.	13 grms.	5 grms.
Observed.. ..	99.05	99.40	99.49	99.56	99.68
Calculated .. .	99.06	99.40	99.48	99.57	99.67

¹ See Lippman's "Chemie der Zuckerarten," Vol. II, pages 1186 to 1190.

The value for the polarization of 26 grms. of sucrose and 3.392 grms. of NH_4Cl as calculated by Dr. JACKSON and Miss GILLIS on page 164 of their bulletin is 99.43, which differs by only 0.03 from the value found by the writer.

The directions given in Bulletin 375 for calculating the negative constituent of the Clerget divisor are also based upon the assumption that, except for the influence of concentration and temperature, a constant weight of salt in 100 c.c. of solution exerts a constant effect upon the polarization power of invert sugar. This value for 13 grms. of inverted sucrose is given on page 177 of Bulletin 375¹ as $-32.00 - 0.563 m$ for NH_4Cl at 20°C. which calculated for the 3.392 grms. of NH_4Cl used in Method II (pages 184-5)² would be $-32.00 - (0.563 \times 3.392) = -33.91$, this negative constituent entering at the head of the table of divisors and being used in the calculation of all factors in that table.

The difference between the positive and negative constituents $+99.43$ and -33.91 as given at the head of the table of divisors is 133.34, this basic value being the first Clerget divisor of the column marked 50 c.c. $\times 2$ in which half the normal weight of product or 13 grms. is used for the determination. But as shown by the experiments of the writer, the value for the positive constituent of the Clerget divisor for 13 grms. of sucrose and 3.392 grms. of NH_4Cl in 100 c.c. is $+99.57$ instead of $+99.43$. If the negative constituent as determined in Bulletin 375 is correct, then the basic Clerget divisor at the head of the table should be the difference between $+99.57$ and -33.91 or 133.48. This increase of 0.14 would involve, however, an error of about 0.11 in the Clerget determination for 100 per cent. sucrose.

The authors of Bulletin 375 accuse the writer of completely overlooking the effect of NH_4Cl upon the invert polarization, and state that the effect of this salt is quantitatively compensating upon the two polarizations. If this most remarkable coincidence be true, then the negative constituent of the Clerget divisor at the head of the table of divisors of Method 2 must be -33.77 in order that the difference between it and the positive constituent $+99.57$ may equal 133.34. But the authors of Bulletin 375 have already stated the negative constituents to equal $-32.00 - 0.563 m$, which is -33.91 and not -33.77 . They are, therefore, confronted with the unavoidable dilemma of stating whether it is their formulas or their tables that are wrong. If they assume that their tables are accurate, they are then obliged to admit that they have been calculated by two incorrect formulas whose errors of result are in all cases quantitatively compensating. The possibility of such an exact coincidence is almost one to infinity. Correct results are never obtained by the application of faulty principles. The defense of compensating errors is not only a futile but a risky form of argument. Dr. JACKSON and Miss GILLIS say nothing about this quantitative compensation of influences in Bulletin 375, and their calculations take no account of it. The figures of their tables are based upon certain prescribed formulas and the present discussion relates entirely to the correctness of those formulas as they now stand.

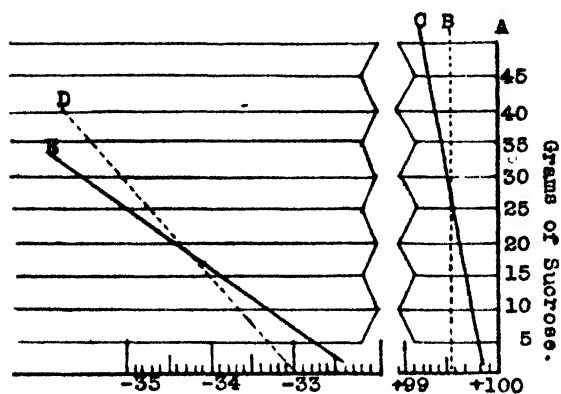
In order to determine the extent to which the errors of the formulas of Bulletin 375 for calculating the positive and negative constituents of the Clerget divisor are compensating, it will be necessary to consider briefly the influence of ammonium chloride solution upon the polarising power of invert sugar. This influence is more difficult to study than is the case with sucrose, owing to the changes in rotation produced by variations in concentration of sugar as well as in water content of solution. The combination of effects, according to the writer's experiments, proceeds very nearly in a straight line, and for graphic purposes may

¹ I.S.J., 1920, 673.² I.S.J., 1920, 640.

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be expressed with sufficient accuracy by the formula $-32.40 - 0.1g = p'$, in which g represents the grms. of sucrose taken for inversion and p' the negative constituent at 20°C . of the Clerget divisor for Methods II and III of Bulletin 375.¹

The general relation of the positive and negative constituents of the Clerget divisors, now under discussion, is shown in the accompanying diagram, in which the dotted vertical line B and the dotted inclined line D represent respectively the positive and negative constituents according to the Jackson-Gillis formulas, and the continuous inclined lines C and E represent respectively the positive and negative constituents according to the writer's experiments. It will be noted that the points where the two sets of lines intersect are at about 26 grms. sucrose for the positive constituents, and at about 15.5 grms. sucrose for the negative constituents, these weights of sugar being respectively the quantities upon which the determinations of Bulletin 375 were based. From these points



DIAGRAM

the two sets of lines diverge. The agreement of distance on any horizontal between the pair of lines B, C , with the distance on the same horizontal between the pair of lines D, E , represents the extent to which the errors of the positive and negative constituents of method 2 are compensating. It will be seen that the errors in determining the two constituents do to a considerable extent neutralize each other. Compensation is perfect at only one point, which happens to be at about 13 grms. of sucrose. Below this point the Clerget divisors of method 2 become gradually greater and above this point gradually smaller than the divisors found by actual experiment.

As to the extent of the errors which may result from the use of the table of divisors of Method 2, this will depend largely upon the method of procedure. One great objection to this particular modification of the method of neutral polarization is that the analyst is compelled by the requirements to make his direct polarization at the same concentration of substance used for the invert polarization. This, in the case of substances whose solutions darken during inversion, may necessitate such a dilution of material that the errors of the direct polarization become greatly multiplied. The direct Clerget reading, which usually makes up about 80 per cent. of the value $p - p'$, should be made whenever possible upon a full normal weight of substance, and this is not possible in the procedure outlined on page 184 of Bulletin 375.¹

While the authors of Bulletin 375 may perhaps be satisfied with the compensation of errors in their Method 2 as applied to dilute sucrose solutions, they will possibly think differently about this with regard to some of their other methods. An old proverb states that one cannot have his cake and eat it at the same time. Having adopted the dangerous principle of compensating influences in case of Method 2, they must also in order to be consistent apply it to their Method 3. In this Clerget modification, which is designed for the analysis of beet products,

¹ I.S.J., 1920, 640-641.

¹ I.S.J., 1920, 640.

the clarified filtrate is polarized directly without the addition of NH_4Cl , the positive constituent being entered at the head of Table 18 in this case as + 100. The inverted solution on the other hand is neutralized with ammonia, in which case the reading of 13 grms. of inverted sucrose + 3.392 grms. NH_4Cl multiplied by 2 is given, as in Method 2, as - 33.91, this value being entered at the head of the table of divisors of Method 3 as the negative constituent. The sum of these gives the Clerget divisor 133.91 which is entered at the beginning of the table as the first Clerget divisor. It is here that the defence of compensating errors or influences fails completely, for there is no compensation. The positive constituent of Method 3 is indicated in the diagram by the vertical line *A* and the negative constituent as before by the dotted line *D*. The distances on the horizontals between the pair of lines *D*, *E*, represent the errors of the method, which in this case are considerable. The only point where correct readings are obtained is at 15.5 grms. of sucrose. Below this point the Clerget divisors become rapidly greater with the result that lower percentages of sucrose are obtained. The writer does not believe that the producers of beet molasses would care to sell their product upon the results of this particular method.

We believe it to be demonstrated, that not only are the basic formulas of Scientific Paper No. 375 of the Bureau of Standards, erroneous, but also that the tables based upon these formulas are likewise erroneous. These formulas and tables can no doubt be modified so as to give accurate results upon solutions of pure sucrose. This, however, does not remove the error mentioned by the writer in his previous paper as inherent in the general method of neutral polarization, which is designed for the analysis of complex mixtures. In many concentrated products the sucrose makes up only a part of the soluble carbohydrates, in which cases the Clerget divisor will not be dependent upon the $P' - P$ value alone, but upon the water content of the solution. Numerous experiments could be given to demonstrate this, but these must be reserved for another occasion.

The writer believes on general principles that the less the direct and invert polarizations of the Clerget method be disturbed by the addition of salts and other substances, the better for the accuracy of the method. Such additions may in fact produce worse errors than the faults which they are intended to correct. It is for this very reason that he has preferred the invertase method for very accurate research, invertase having also the additional advantage that the inverted solution is not darkened as with acids. Conditions are bad enough even with invertase in the case of molasses and similar products which contain soluble sulphates, chlorides, and other salts that act upon the rotations of the dissolved sugars. So, as the writer has always contended, when we apply the Clerget method as established upon solutions of pure sugars to mixed products that contain all sorts of impurities, the results at best are only a more or less satisfactory approximation.

The methods of acid inversion that are most free from the objections discussed in this paper, are those that completely remove the acid at the end of inversion without leaving any soluble salts in solution. DEERR¹ has devised a method of this kind in which sulphuric acid is used for inversion, and the acid afterwards precipitated with barium hydroxide. The details of this procedure have not been sufficiently worked out, but the principle of the method is sound and it deserves to be developed. We believe it is to be along the line proposed by DEERR that future improvements in the process of acid inversion for the Clerget method are to be

¹ *I.S.J.*, 1915, 179.

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derived, and not along the line of the modifications proposed by the authors of the Bureau of Standards Scientific Paper No. 375.

The writer desires in concluding this discussion, to acknowledge the services performed by his assistants, C. A. GAMBLE, G. H. HARDEN and M. H. WILEY, in the experimental part of the investigation.

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The Fulton Double Crusher.

Among cane sugar manufacturers there has always existed the great problem of the proper preparation of cane for milling. In no other branch of sugar work has more effort been expended and more different designs and plans been tried than in this one.

FISKE in Louisiana constructed what later became known as the "National" shredder, consisting essentially of two shafts carrying conical cutting discs which dovetail or mesh into one another. These shafts are rapidly revolved in opposite directions and at different rates of speed. The cane was torn into shreds, but the little juice separated was immediately re-absorbed by the cane. This method not only did not satisfactorily prepare the cane for the mill, but it also lost the juice that was extracted. The great disadvantage of this process lay in the frequent breakage of the rapidly moving parts together with the small output of shredded cane.

KRAJEWSKI introduced the diagonal meshing grooves on two opposed rolls. Here there was a gain in quantity of cane prepared, but the preparation was so incomplete, in that the cane was only flattened and cut and not shredded.

There have been many similar attempts to solve the problem of proper preparation. Many of the so-called "shredders" are theoretically perfect; but when in operation, the loss of time due to breakage of the fragile parts and the low output of cane have rendered them impracticable.

This problem has engaged the attention of the Fulton Iron Works Company for years, and finally by long experimenting and testing they have evolved and patented¹ a unit known as the Double Crusher, adaptable to any type or size of mill. The Fulton Double Crusher is a 4-roller unit, all rolls working under hydraulic pressure, attaining pressures upward to 400 tons. The grooving of the rolls is entirely different from other types, each roll having annular grooving to exert the tremendous double pressures upon the cane. In addition, the rolls are grooved diagonally towards the centre with an unequal groove, the high shoulder to the rear. This diagonal grooving introduced a new principle, that of forcible feeding into the rolls.

Also the first two rolls have coarser grooving to take the unbroken cane, while the second two rolls carry smaller grooves to reduce the partially broken cane to a fine shredded mat. The operation of the double crusher in practice may be stated to have practically revolutionized the milling practices of the cane sugar world. In addition to a greatly increased amount of finely shredded cane produced, the unit is so constructed that actually 65 per cent. of the juice is extracted before the cane reaches the mill proper, providing a fine shredded mat for the milling and maceration that follows.

It may be of interest to learn that the Double Crusher has been adopted as standard equipment by most of the large Centrals of Cuba.

The Fulton Iron Works Company of St. Louis, U.S.A., invite correspondence, and offer to reply to technical questions put by anyone writing to them at their address.

¹ *I.S.J.*, 1910, 408, 471; 1920, 408.

Clarification of Cane Juice for the Manufacture of White Sugar, using Magnesium Acetate.

Mr. MİGAKU İSHIDA, of the Sugar Experiment Station, Formosa, has published a bulletin¹ in which he proposes a new method of juice clarification for white sugar manufacture, called by him the "double ammonio-defecation process." His method of operating is to heat raw juice, treat with ammonia and magnesium acetate, subside, treat with milk-of-lime, and again subside. This procedure is said to raise the purity about 7°, "the expense in the sugar factory per picul of sugar being about one-third of the ordinary carbonatation process." The quality of the sugar produced by the new process is said to be "better than No. 25 of the Dutch standard, and nearly the same as that of the double carbonatation process, and better than that produced by sulphitation"; while the yield is stated to be, if not higher, certainly not lower than in other processes. Some extracts from this publication (which is the first technical bulletin in English issued by the Formosa Station) may be made.

LABORATORY EXPERIMENTS.

The writer's first plan was to improve the ordinary defecation process; and with this purpose in view the effect of several reagents was tried, the best results being obtained with ammonia and ammonium acetate, follow by lime. It was intended to employ some colloidal substance, as aluminium or magnesium hydroxide, which could be prepared from the sulphate by the use of ammonia or other alkali; and it was finally decided to utilize a magnesium compound, "as it is readily obtainable and at a low cost."

This new method of forming magnesium hydroxide in the juice seemed to be very efficient in its clarifying action. A 15 per cent. solution of ammonia, and a 1.81 per cent. solution of magnesium acetate, were prepared; and a number of experiments carried out, some of the conclusions from which are as follows:— (1) Caramel is removed from its solution by these reagents, 75 c.c. of a solution of caramel being treated with 3 c.c. of ammonia (15 per cent.), and 10 c.c. of magnesium acetate (1.81 per cent.), boiled and filtered, when on examining the degree of colour in the Stammer instrument it was concluded that caramel had been eliminated. (2) Solutions of dextro-rotatory amino-acids, and of amino-acid amides, are rendered optically inactive. (3) Glucose in the proportion in which it occurs in cane juice is not affected by the new treatment, nor is levulose.

Incidentally, it occurred to the writer that the proposed reagents might be applied as a clarifying treatment in the analysis of raw sugars, the procedure being to add 50 c.c. of 10 c.c. of magnesium acetate (1.81 per cent.), and 5 c.c. of ammonia (15 per cent.), to complete to 100 c.c. with water, and to filter. As a control, 2 c.c. of basic lead acetate were added to 50 c.c. of the same juice, the volume made up to 100 c.c., and the liquid filtered. The polarization in both cases was the same, viz., 19.70.

In the laboratory experiments on the application of magnesium acetate as a possible technical process, lime was not used at first. In one of the experiments, 0.14 c.c. of 15 per cent. ammonia, and 0.28 c.c. of 1.82 per cent. magnesium acetate solution, were added to every 100 c.c. of the raw juice. Originally the purity was 78.80, but this treatment raised this value to 82.26°. Less satisfactory results were obtained with smaller amounts of the reagents.

¹ Bulletin No. 1, entitled "A contribution to the Chemistry of the Clarification of Cane Juice and of Sugar Manufacture," by MİGAKU İSHIDA, published by the Government Sugar Station, Formosa, Japan. It contains 62 pages.

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Later, however, it was observed that a further improved effect could be realized by the use of lime after adding the two reagents. For example, in one of the writer's experiments 500 c.c. of raw juice heated to 80°C. were treated with the reagents at the rate of 0.08 c.c. of ammonia, and 0.25 c.c. of magnesium acetate solution per 100 c.c., and allowed to subside an hour. At the end of this time, the clear liquid was drawn off, treated with milk-of-lime (15°Bé.) at the rate of 0.4 c.c. per 100 c.c. of juice. Another lot of 500 c.c. of the same juice was submitted to ordinary defecation, by adding 2 c.c. of milk-of-lime (15°Bé.), and heating to boiling point, and subsiding. These were the results obtained :

	BRIX.		POLARIZATION.		PURITY.
Raw cane juice.. . . .	17.9	....	13.8°	....	77.09
Ordinary defecation	18.8	....	15.0°	....	79.79
New double clarification..	18.0	...	15.3°	....	85.00

Other tests showed that the effect of the new process was to remove 80 per cent. of the pectins and gums, 25 per cent. of the nitrogenous substances, and about 30 per cent. of the ash. Calcium oxide increased about 60 per cent. of that originally present in the raw juice.

APPLICATION ON THE FACTORY SCALE.

It is pointed out that in applying these reagents to factory practice, only a few additions to the ordinary equipment would be necessary, viz., more subsiding tanks and a set of Danek filters for the syrup.

The writer proposes to prepare the ammonia from ammonium sulphate and calcium hydroxide (using an apparatus similar to that of Grueneberg); while magnesium acetate would be made from the carbonate and acetic acid, keeping the liquid alkaline to litmus.¹ Concluding, it is stated that "this new process has proved its worth theoretically and practically, and has been shown to be easily applicable to the ordinary raw sugar factory. Its reagents can be prepared in any sugar factory. Besides, the yield is not low (no inversion occurring), and the sugar produced is of a high grade, while neither the expense of the clarifying agents nor the cost of production exceeds that of other processes."

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SIAM'S SUGAR TRADE.

During the last 10 years a revival of interest in the sugar industry of Siam has taken place and unrefined sugar has again been listed as an export from the kingdom. During the fiscal year ended March 31, 1920, the exports of unrefined sugar to foreign countries from Siam reached 71,776 piculs (9,570,133 lbs.) valued at 1,757,190 ticals (\$651,741), as compared with 42,847 piculs (5,712,933 lbs.), valued at 365,564 ticals (\$135,587), in 1918-19; 11,374 piculs (1,516,533 lbs.), valued at 99,840 ticals (\$37,030), in 1917-18; and 170 piculs (22,667 lbs.), valued at 1,070 ticals (\$396), in the pre-war fiscal year ended March 31, 1914. Considerable amounts of sugar are also derived from the palmyra palm trees, but no regular cultivation of these palms is carried on at present. Siam's sugar exports are generally intended for immediate oriental ports only, but in 1919 4000 piculs (533,333 lbs.) were also shipped to Japan.

Practically all of Siam's supplies of sugar are shipped from oriental ports and, according to the customs entries at Bangkok, consist of manufactured sugar and molasses. The

¹ Magnesium carbonate is quoted on the London market to-day at about £30 per ton, f.o.b., including packages; and acetic acid (80 per cent.) at about £48 per ton. - (Editor, *I.S.J.*).

² Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

quantities and values of the imports of sugar and molasses from foreign countries for the two fiscal years ended March 31, 1919 and 1920, as compared with those for the pre-war fiscal twelvemonth ended March 31, 1914, are shown in the following table, the quantities being given in kilos of 2·2 lbs. each and values in ticals, worth nominally 37·09 cents:—

ARTICLES	1913-14		1918-19		1919-20	
	Kilos	Ticals	Kilos	Ticals	Kilos	Ticals
Manufactured						
sugar....	20,545,101..	3,281,141..	15,435,262..	3,631,331..	9,843,149..	5,339,682
Molasses	6,384,051..	179,379..	7,676,224..	481,933..	20,198,070..	1,973,887

In July, 1920, the retail price for finest Hongkong soft sugar was given at 0·55 tical (\$0·20) per lb. and in bags of 10 lbs. at 4·75 ticals (\$1·76); finest Hongkong cube sugar per 3 lb. tins at 2·5 ticals (\$0·93) each, and in 5 lb. tins at 4 ticals (\$1·48) per tin; common brown sugar at 0·3 tical (\$0·11) per lb. It is understood that the bulk of the molasses imports is used for the distilling of native liquors for local consumption. The import duty on all kinds of sugar and its preparations is 3 per cent. ad valorem. As far as can be ascertained, there has as yet been no demand in this country for machinery used in the production and refining of sugar.

OPPORTUNITIES FOR SUGAR MACHINERY IN INDIA.

India devotes more acreage to sugar cane than any other country in the world, but in spite of this she is a very heavy importer of sugar. The Government of India has adopted a definite policy of industrializing the country, and very active steps are being taken to encourage improvements in all technical matters wherever possible. In this connexion special efforts are being made to modernize the entire Indian sugar industry, which is a difficult undertaking, as the problem in this industry is extremely complicated and changes materially from Province to Province. The scarcity of water, the peculiar system of land tenure, and the conservatism and suspicious nature of the farmer make the growing of cane a difficult matter, especially when efforts are made to secure the land required by a first-class sugar central. On the other hand, there are other locations where it would probably be possible for those interested to secure a sufficient acreage of suitable land that could be irrigated to adequately meet the requirements of modern sugar production.

It seems evident that it will be necessary to carry on the industry on both a small and a large scale, and there will probably be a very heavy demand for all kinds of sugar machinery from the three-roller mills driven by steam, animal, and water power to the larger plants of the complete modern central. A new policy of the Government to make India as nearly self-supporting as possible will encourage the local manufacture of this machinery in so far as possible. Though iron and steel have been produced in India at what are understood to be attractive prices, especially in connexion with the Tata Steel Works, it does not seem possible that all the plant needed could be locally manufactured, especially as the country produces only pig iron and a few qualities of steel, so that a great many materials normally needed in the manufacture of sugar machinery would not be available. Furthermore, the expense involved in developing designs and patterns for this quality of equipment would probably be prohibitive on account of cost and time.

In order to study this subject and discover the ways in which improvements could be made to the best advantage, the Government of India appointed a special committee which has been engaged on the subject about two years. This committee should soon be ready to report its final conclusions, as practically every Province in the Indian Empire has been visited and a very large number of witnesses interviewed. From information so far ascertained it has been learned that the sugar committee has decided to organize a corporation capitalized at 50,000,000 rupees for the purpose of manufacturing machinery for the sugar industry throughout India. The committee is trying to arrange suitable connexion with either an American or British engineering company of extensive experience in the sugar business who could provide the necessary technical knowledge for this enterprise. Although it is obvious that the Government of India would prefer to have this connexion made with a British firm, the possibilities for a successful American connexion of this sort

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are deserving of the most active and careful attention on the part of those who are interested in undertaking such a venture. It is evident that engineers who make this connexion will be in a position to supply such machinery as can not be produced in India.—[Trade Commissioner's Report, March, 1921.]

INCREASING AUSTRIA'S SUPPLY OF SUGAR.

In the first part of December, 1920, a new sugar factory was put into operation in Subern, Upper Austria. In the course of a month it worked up about 80 tons of beets and produced about 60 tons of crystal sugar. The employees now number 170, and the company is capitalized at 40,000,000 crowns. According to the *Linzer Volksblatt*, arrangements have also been completed for setting up a second new sugar factory at Marchtrenk, Upper Austria.

The output of these two factories will be a small but welcome addition to the inland supply of sugar. At present there are four factories in Austria employing, according to the latest available reports, 2084 workers. They are the Oesterreichische Zuckerindustrie Aktien Gesellschaft, Bruck a'd Leitha, the Durnkruter Zuckerfabrik Aktien Gesellschaft, Durnkrut, headquarters in Wien, I Elisabethstrasse 18; the Hohenauer Zuckerfabrik der Brueder Strakosch, Hohenau, office in Wien, I Hegelgasse 19; and the Leipnik-Lundenburger-Zuckerfabrik Aktien Gesellschaft, Leopoldsdorf, near Gros Enzersdorf. Their output during 1920, as given by newspaper reports, was 5000 tons. The estimate last fall of the Food Administration was 12,000 tons for the fiscal year 1920-21.

In Burgenland, the territory of West Hungary transferred to Austria by the Treaty of St. Germain, there are four sugar factories. When beets were available before the war their production was approximately 44,000 tons of sugar annually.

The yearly consumption of sugar has been estimated by the Foreign Office and the Food Administration at 125,000 tons per year. During the present fiscal year all but 12,000 tons was to be supplied by imports, purchased at a cost reckoned in the summer of 1920 at \$304 per metric ton. Czechoslovakia, Switzerland, and the Netherlands furnish sugar to Austria, molasses comes from Czechoslovakia.—[Consular Report, January, 1921.]

RECOVERY OF THE BEET SUGAR INDUSTRY IN FRANCE.

A forecast by the French Ministry of Agriculture indicates that the French beet sugar production from the crop of 1924-25 will probably reach 590,000 metric tons, or 68 per cent of its normal pre-war output. During 1913-14, the last crop year before the war, there were in France 213 factories operating, producing 864,814 metric tons of 100° sugar, at an average of 16.95 per cent. extraction, from 6,674,022 tons of beets grown on 566,309 acres of land. During the war there were destroyed completely 135 sugar factories, located in the ravaged areas of the northern departments. There remained intact 78 factories, but with heavy plant deterioration due to enforced idleness, a deterioration necessitating repairs or replacement of the most expensive equipment, such as slicing machinery, pumping systems, triple and quadruple effects, vacuum pans, crystallizers, and centrifugal machines.

In 1914-19, the first crop year after the war, French usines produced 107,841 tons of beet sugar. In 1919-20, the sugar output rose to 152,332 tons from 163,496 acres of beets, at an average extraction of 17.57 per cent. of the weight of beets sliced. The average extraction of 100° sugar for 10 years prior to 1914 was about 16 per cent. For the present crop of 1920-21 there were sown in beets 202,230 acres; the average extraction to date is 17.69 per cent. and the estimated sugar production will be 350,000 tons at 11.0° polarization, thus exceeding an earlier estimate of 250,000 tons. The increased sugar extraction, it should be observed, is due to deep ploughing of land which had lain fallow for four years, more thorough cultivation, and heavier fertilization with potash now available at reduced cost from the Alsace-Lorraine deposits. The daily slicing capacity of factories now in operation is 2375 tons of beets, and those usines about to resume grinding will have an additional beet capacity of about 3000 tons per day.

Future sugar production per crop is estimated as follows: 1922-23 crop, 460,000 tons; 1923-24 crop, 550,000 tons; 1924-25 crop, 590,000 tons.

It is also estimated that to complete the rehabilitation of the French beet sugar industry there will be required an additional expenditure of about \$4,825,000 (with the franc at 19·3 cents).—[Consular Report, February, 1921.]

PRODUCTION OF BLACKSTRAP MOLASSES IN CUBA.

The principal dealers in Cuban blackstrap molasses state that a fair average analysis of this product will show 10 to 17 per cent. water, 36 per cent. Clerget sugars, 16 per cent. glucose, and the remainder fibre, gums, and salts, these last named being by-products which are not now utilized. It is claimed that under an efficient process the average gallon of blackstrap molasses will distil from 0·3 to 0·5 gallon proof alcohol. It would, therefore, appear that few products are better adapted to the manufacture of alcohol. Producers and dealers in this island express the opinion that the demand for blackstrap molasses will steadily increase, especially if alcohol comes into general use as a substitute for gasoline in running motors. Moreover, it is believed that the growing demand for the use of raw molasses in the manufacture of certain stock foods will offset the loss of the market occasioned by the prohibition of the manufacture of alcoholic beverages in the United States.

Due to the high price of sugar as compared with that of molasses, this latter product is often burned by the sugar mills as fuel in connexion with other refuse, instead of being stored by them until shipment can be made. A proper interest in the storage and conservation of blackstrap molasses by the sugar mills depends largely on the offering of a fair market price; and if excessive profits are gained by any of the parties handling the product, the margin will become too narrow to be profitable to the others.

A more careful conservation would also create a demand for steel storage tanks both at the sugar mills and various points of shipment. It is stated that the port of Matanzas has storage capacity for over 16,000,000 gallons; Habana, 8,000,000; Cienfuegos, 6,000,000; Santiago de Cuba, Monaco, Jucaro, Antilla, Nuevitán, and Puerto Padre, 2,000,000 to 3,000,000 gallons each; Boqueron, Caibarien, and Sagua under 2,000,000 gallons each. Important improvements are under way at Matanzas and it is believed additional storage will soon be available at that point. Shippers of molasses claim a total of approximately 765 tank cars of 5000 gallons each, and the United Railways have available some 40 tank cars of less capacity.

The following figures given by the Cuban Government cover the quantities of molasses exported during the years 1917 and 1918, also the first six months of 1919. Statistics beyond this date are not yet available. It is, however, estimated that the production for 1920 has reached 180,000,000 gallons; of this amount probably 20,000,000 to 30,000,000 gallons have been used locally in the manufacture of fuel alcohol.

COUNTRY.	1917.	1918	1919 *
	GALLONS	GALLONS.	GALLONS
United States.. . . .	179,244,289	161,033,117	45,925,447
Canada.. . . .	—	224,737	—
British West Indies .. .	—	—	5,600
France.. . . .	4,371	—	—
England	19,945,062	2,458,365	3,851,284
Total	199,193,722	163,716,219	49,782,231

[Consular Report, January, 1921.]

Dr. CARL L. ALSBERG, Chief of the U.S. Bureau of Chemistry, recently said that "additional and more exact information regarding the character and properties of colloidal matter in cane juice is necessary in order to remove to as great an extent as possible substances interfering with crystallization. . . . This problem of clarification constitutes the very essence of sugar manufacturing problems. . . . The prosecution to a successful issue of such investigation as the Bureau of Chemistry has in progress will result in reducing the present manufacturing methods to a more scientific and exact basis. . . ."

* First six months.

Publications Received.

Anleitung zum Nachweis, zur Trennung und Bestimmung der Reinen und aus Glukosiden usw. erhaltenen Monosaccharide und Aldehydsäuren. [Introduction to the Detection, Separation, and Determination of Monosaccharides and Aldehyde Acids, Pure and Derived from Glucosides, etc.]. A. W. van der Haar. (Gebrüder Borntraeger, Berlin.) 1920. Price: 64 marks.

Dr. VAN DER HAAR whose name is known as an investigator in the domain of the chemistry of the sugars, particularly in that branch of the subject connected with the glucosides, has written a book which will surely be found of great service to others whose studies are likewise turned in this direction. It is based to a large extent on the author's own laboratory work; and on turning over the pages one is impressed with the fact that he must have personally verified most of the methods of technique described, and a good number of the experimental results as well. In the introduction there is a useful discussion concerning the true nature of those saccharides which in the earlier literature of the subject have been indicated by fanciful names such as cerasinose, prunose, scammonose, traganthose, and the like. Following this are the 10 chapters into which the book is divided, dealing successively with the properties of the less generally occurring monosaccharides; identification in general, and of the saccharides by means of their hydrazine compounds in particular; qualitative reaction of the monosaccharides; quantitative determination of the monosaccharides alone and in admixture; methods of formation, melting point, properties, and identification of the hydrazones and hydrazines of monosaccharides; procedures for the analysis of glucosides; and lastly a chapter dealing largely with the author's own work on the products of the hydrolysis of apricot gum, tragacanth gum, and the saccharides and acids obtained from the chestnut seed saponins. Students working in the rather difficult line of research with which this book deals will welcome it as a practical treatise of special interest. It is in fact a valuable and original addition to the literature of the chemistry of the sugars, and its publication reflects much credit upon the experience and the industry of its writer.

"Sucrerie, Distillerie, Industries - Agricoles."—The proprietors of the *Journal des Fabricants de Sucre de France* have issued a new publication bearing the above title, and we have pleasure in welcoming the first issue, which is certainly an interesting one. It contains a number of articles by well-known writers on topics engaging attention at the present time; for example, a comparison between the sugar industries in Cuba and Java, by Dr. PRINSEN GEERLIGS; the condition of the sugar and distilling industries in the devastated areas in France, by Mr. MAURICE PELLET; the state of the sugar industry in Poland, by Dr. J. FREJLICH; and on the agricultural resources of Cuba, by Mr. E. JUMELLE. Interspersed with such articles on the technical and commercial condition of our time, there are notes and illustrations concerning subjects and *savants* of earlier days. Thus some particulars are given of the work of PÈRE LABAT, NICOLAS DEYEUX (who made the first loaf of sugar from the beet), and ANTOINE BAUMÉ, while some old prints concerning distilling are also reproduced. This publication (which is printed in French and Spanish) has our best wishes for its success.

Industrial Alcohol under the New Law and Regulations. By Burnell R. Tunison. (Reprinted from *Chemical and Metallurgical Engineering*, 1920, 22, No. 11.)

Its contents include: Dual purpose of the (United States) act; authorized uses of intoxicating liquors; procedure necessary to use tax-free alcohol; denatured alcohol; authorized formulae of specially denatured alcohol (33 mixtures are specified); sp. gr. and weight of 1 gall. (U.S.) of specially denatured alcohol.

Chemical Engineering Catalog, 1920. Fifth Edition. (The Chemical Catalog Co., 1, Madison Ave., New York, U.S.A.)

Attention has already been called to the first and second editions of this valuable publication.¹ It is a compilation of condensed catalogue data of manufacturers in the United States catering for the chemical industries, and in fact consists in the words of the publishers of a "room-full of individual catalogs, abstracted, indexed, and assembled within the covers of a single book." It is indeed a most useful compilation, if only for the succinct descriptions and clear illustrations of the plant now used in the American chemical industry. A special Committee, consisting of specialists, appointed by the American Institute of Chemical Engineers, the American Chemical Society, and the Society of Chemical Industry, was appointed to supervise its compilation and formulate the specifications and standards. The public-spirited co-operation of these gentlemen with the publishers has resulted in a standard work that will prove of the greatest service to engineers and chemists engaged in every line of manufacture. It should be explained that the Catalog is leased at \$2.00 a copy for the period of one year to chemical engineers of responsible position, and that 11,500 copies have been printed for distribution.

Volumetric Analysis. Charles H. Hampshire, B.Sc., F.I.C. Third Edition. (J. & A. Churchill, London.) 1921. Price: 7s. 6d. net.

In 1919 we drew attention to the publication of this useful small work on volumetric analysis.² It is an elementary book, serving well as an introduction to the more comprehensive treatises, as, for example, that written by SUTTON. In this third edition the scope of the volume remains about the same as in the first issue, but some new determinations have been added, and the section on indicators has been extended. As we remarked previously, it provides an excellent first course in volumetric analysis, in which the matter has been arranged with great clearness.

Destruction of Rats.³ (Ministry of Agriculture and Fisheries, Publications Branch, London, S.W. 1.) Gratis.

Contents: Damage done by rats; preventative measures; remedial measures; (hunting, trapping, poisoning, fumigating); need for combined effort; mice.

Die Trocknung Landwirtschaftlicher Produkte (Drying of Agricultural Products). N. Nehbel. (M. and H. Schaper, Hanover.) 300 pages and 133 illustrations. 1920.

Stammer's Taschenkalender für Zuckerfabrikanten (Stammer's Pocket-Book for Sugar Manufacturers). (Paul Parey, Berlin.) 1920.

Zucker und Zuckerwaren, mit Einschluss von Starkezucker und Starke-syrup (Sugar and Saccharine Products, including Starch Glucose). P. Neumann. 154 pages. (Akademische Verlagsgesellschaft m. b. H., Leipzig.) 1920. Price: M. 40 plus 180 per cent.

Über neuere Methoden der Honiguntersuchung. [Newer Methods of Honey Examination.] Prof. J. Fiehe. (Akademische Verlagsgesellschaft m. b. H., Leipzig.) 1920. M. 36 plus 180 per cent.

Der Honig und seine Ersatzmittel. [Honey and its Substitutes.] Prof. J. Fiehe. (Akademische Verlagsgesellschaft m. b. H., Leipzig.) 1920. M. 26 plus 180 per cent.

¹ I.S.J., 1917, 233, 1919, 286.

² I.S.J., 1919, 572.

³ See also article by E. C. REED in the *Journal of the Ministry of Agriculture*, 1921, 27, No 11, 1052-1055.

Review of Current Technical Literature.¹

INFLUENCE OF BAGACILLO UPON THE QUALITY OF THE RAW SUGAR MADE IN HAWAII.

R. C. Pitcairn. Paper presented to the Committee on Manufacture of Sugar and Utilization of By-Products, Hawaiian Sugar Chemists' Association, 1920.

It is assumed by many that in factories in which shredders, knives, and other appliances are used; the cane is disintegrated to such an extent that the increased amount of *bagacillo* produced affects the nature of the juice, and in turn the boiling conditions. However, the author says that he is of the opinion that such practice is not injurious to the making of a good quality of raw sugar for refining. He cites analyses showing that the ash content at any rate of the raw sugar made in a factory equipped with such appliances is about the same as in the case of a mill operating with an older installation. He is inclined rather to believe that the heavy ash content of Hawaiian sugars is due to the following three conditions:—(1) The character of the cane ground, it being noticeable, for example, that on Maui the difference of the ash in the first mill juices (filtered and unfiltered) obtained from Lahaina and D 1125 was as much as 25 per cent. (2) The amount of molasses left adhering to the crystals, which is believed to be remedied by a more even mechanical application of wash-water, so as to carry a lower No. 1 massecuite and send to the refinery a cleaner crystal. (3) The system largely used of boiling-back all the remelt of the low-grade massecuite into different grades of pans, which depends for its efficiency entirely on the equipment at disposal. The cheapest method of improving matters would seem to ascertain the lowest economical purity to which the remelt can be carried to give a satisfactory No. 1 sugar; and then arrange matters so that the remelt may be repurged if its purity is too low, using a separate installation. At Wailuku this idea was tried with a small machine, it being found possible to raise the purity of a remelt from 67–70° to 86–90° in a very few minutes. The molasses from this second purging would be too high for discarding, and so would have to be collected and boiled separately and purged. Too large a grain militates against absolute recovery, and too small a crystal adversely influences the time of purging. At Wailuku, the author's experience has been that a 0.4 mm. grain for the low grade sugar gives the best results, the evenness and number of these grains being the governing factors in their purging in the centrifugals. All low grade pans during the previous season were grained at Wailuku by the "seeding" method using white sugar dust,² adding 1 lb. to every 1000 cub. ft. of the finished massecuite.

DETERMINATION OF THE DRY SUBSTANCE (AND WATER CONTENT) OF SYRUPS, MASSECUITES, AND MOLASSES, BY MEANS OF THE REFRACTOMETER WITHOUT PREVIOUS SEPARATION OF THE CRYSTALS. H. Kalshoven. *Archief*, 1920, 28, No. 23, 913-917.

A short review is made of the literature leading up to the publication of Skola's useful contribution³ demonstrating that the refraction of the mother-syrup may be ascertained even in the presence of crystals. MÜLLER⁴ in 1898 published a paper describing a "saccharo-refractometer," by means of which the refraction of a dark and cloudy juice could be read. HAZEWINKEL⁵ mixed syrup with gypsum, and observed that the refractive index remained the same as in the case of the originally clear liquor, although successive observations showed the density by the hydrometer gradually to decrease owing to the separation of the solid matter. FOUQUET⁶ noticed when determining the refraction of syrups that the separation of fine grain during the cooling of the liquid did not hinder the reliability of the reading. MEZZADROLI⁷ demonstrated that by taking the refractive index of beet pulp, one obtained a reading corresponding to the dry substance of the surrounding juice; and he also remarked in passing that the dry substance of massecuites could be

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

² *I.S.J.*, 1919, 36.

³ *I.S.J.*, 1921, 169.

⁴ *Archief*, 1898, 898.

⁵ *Ibid.*, 1908, 519.

⁶ *Bull. Assoc. Chém. Sucr.*, 1908-9, 81-2.

⁷ Referred to by PELLET, *I.S.J.*, 1914, 521.

determined refractometrically without taking the trouble to separate the crystals. About the same time, experiments had shown SIDERSKY¹ the difficulty of effecting a quantitative separation of crystals and mother-liquor in samples of massecuite; and so in order to obtain an insight into the exhaustion of syrups he (a) determined the dry substance of the massecuite refractometrically after 1 : 1 dilution; and (b) ascertained the refraction of the mother-liquor in the presence of fine crystals. In the calculation of the results obtained, if A is the water content, B the matter in solution, and C the crystal content of the massecuite, then A (which is determined) is $100 - (B + C)$. Further, if A^1 in the case of the mother-liquor is the water content, and B^1 the matter in solution, and if A^1 is determined, then $B^1 = 100 - A^1$. And $\frac{A}{B} = \frac{A^1}{B^1} \therefore B = \frac{AB^1}{A^1}$. In commenting upon his own work on this subject, Mr. KALSHOVEN points out that the method elaborated by him² may be regarded as a combination of the procedures elaborated by SKOLA and SIDERSKY. However, he no longer uses the lower prism of the refractometer, the massecuite or molasses being pressed with the aid of a small glass plate (reinforced with a piece of copper sheet) against the upper prism, and the reading taken at least 10 mins. after turning on the cooling water.

DETERMINATION OF REDUCING SUGARS (LEVULOSE), USING BORIC ACID. G. van B. Gilmour. *The Analyst*, 1921, 46, No. 538, 3-10.

KLEIN, in 1878, first pointed out the property possessed by boric acid solutions of becoming more acidic on the addition of certain polyatomic alcohols and sugars, combination being assumed to take place with the formation of stronger acids. Sucrose and dextrose have practically no effect when present with levulose even in considerable excess, which observation has led the author to attempt a method of determining levulose by finding to what point a known volume of standard boric acid can be titrated on the addition of a weighed quantity of the levulose mixture, the acid's equivalent of levulose having already been ascertained. In the experimental portion of this paper, an encouraging series of results are given; and it is thought that if the method is carefully standardized fairly accurate estimations can be made. A method such as this, it is pointed out, would be useful in the analysis of syrups and honeys in which the reducing sugars were practically all invert sugar.

INDUSTRIAL AND AGRICULTURAL CHEMISTRY IN THE BRITISH WEST INDIES, WITH SOME ACCOUNT OF THE WORK OF SIR FRANCIS WATIS [ALSO CHEMICAL CONTROL RESULTS OF THE ANTIGUA CENTRAL AND DATA RELATING TO SYRUP MANUFACTURE]. C. A. Browne. *Journal of Industrial Engineering Chemistry*, 1921, 13, No. 1, 78-83.

An interesting general account is given by Dr. BROWNE of the sugar industry in the British West Indies, the present position of other enterprises, as the cultivation of cacao, and rubber, and the production of essential oils and of citric acid, being also outlined. In regard to the Antigua central, the following chemical control data, giving average figures for triennial periods, are quoted:—

	1905-7.	1908-10.	1911-13.	1914-16.	1917-19.
Cane ground, tons	27,106	42,888	61,612	92,302	85,690
Sugar made, tons	2,737	4,693	6,349	9,970	9,586
Sucrose in cane, per cent. ..	14.17	14.37	13.74	12.67	12.79
Sucrose in bagasse, per cent. ..	7.33	6.07	4.61	3.22	2.63
Purity of juice, per cent. ..	87.60	85.38	83.70	83.90	83.83
Recovery of sucrose, per cent. ..	68.43	73.10	72.18	82.06	84.15
Yield of sugar, per cent. ..	10.03	10.93	10.32	10.78	11.20
Price of sugar, per ton	\$49.68	\$56.42	\$53.66	\$69.60	\$103.68

It is remarked that these results show that while there has been a marked increase from year to year in factory efficiency, as shown by the rising recovery of sucrose and the diminishing loss of sugar in bagasse, this gain has been offset by a progressive decrease in

¹ *Bull. Assoc. Chim. Sucr.*, 1913-4, 40.

² *I.S.J.*, 1921, 169.

Review of Current Technical Literature.

the sucrose content and purity of juice in the cane, the cause of which latter circumstance was recently discussed.¹ Cane syrup, or "fancy molasses," as it is locally termed, is made in the old muscovado factories in primitive equipments, the process being as follows:— Juice obtained by crushing cane in small wind-power mills is heated with a little milk-of-lime, insufficient to neutralize the natural acidity; after again heating it is subsided, and drawn off into the *tayehes*, in which it is concentrated to a density of about 36° Bé. hot or 42 Bé. cold, a syrup of a clear wine colour having a most agreeable flavour being obtained. Analysis of this product shows these figures:—

	I.	II.	III.	IV.	V.
Water.. ..	22.4 ..	19.7 ..	19.8 ..	27.1 ..	21.9 ..
Sucrose	46.3 ..	42.1 ..	43.0 ..	44.2 ..	51.0 ..
Reducing sugars ..	27.3 ..	32.8 ..	30.7 ..	24.4 ..	20.0 ..
Ash	1.3 ..	1.9 ..	1.5 ..	3.3 ..	1.8 ..
Non-sugars.. ..	2.7 ..	3.5 ..	5.0 ..	1.0 ..	5.3 ..
Total	100.00 ..	100.00 ..	100.00 ..	100.00 ..	100.00 ..
Direct polarization ..	39.9 ..	35.0 ..	35.1 ..	36.2 ..	47.5 ..
Density degrees Bé..	— ..	41.5 ..	41.2 ..	39.0 ..	41.0 ..

It is shown by these figures that in sample IV evaporation was not carried to the proper degree, while in sample V it was noticed that the inversion was not sufficient to prevent crystallization. A syrup of the so-called "two forties" standard (direct polarization 40° and density 40° Bé.) is the usual aim of the manufacturer, as such a product will keep without crystallization. Unfortunately (it is stated), a large part of this syrup is used by blenders for mixing with low grade molasses, a good product being thus adulterated to improve an inferior one; and many producers now recognise that the only way to secure the consumer getting the syrup in a pure state is to can it at the factory in sealed tins upon which the brand is stamped in raised letters. An appreciative account is given of the work of Sir FRANCIS WATTS since the time he assumed charge of the Antigua laboratory in 1889.²

VOLUMETRIC METHOD FOR THE DETERMINATION OF REDUCING SUGARS, USING POTASSIUM FERROCYANIDE. *A. Jonescu and V. Vargolici. Bul. Soc. Chim. România, 1920, 11, 38-45; through The Analyst, 1920, 45, No. 534, 337-340.*

A method depending on the reduction of potassium ferrocyanide is described: 10 c.c. of a reagent containing 46 grms. of pure potassium ferrocyanide and 56 grms. of potassium hydroxide per litre are boiled with 20 c.c. of water and titrated with dextrose solution (0.5 per cent.) until the yellow colour of the ferrocyanide is reduced completely to colourless ferrocyanide, when 10 c.c. of the dextrose solution should be required; 1 molecule of this sugar reducing 5 of ferrocyanide. In the case of sugar solutions which are dark in colour a few drops of nitric acid may be added to serve as indicator, a red coloration being produced in the presence of a trace of the sugar.

STARCH, ITS POLARIMETRIC DETERMINATION. *C. Mannich and Käthe Lenz. Zeitschrift für Nahrungs-Genussmittel, 1920, 40, 1-11.*

Starch is soluble in hot concentrated calcium chloride, a slight acidity (insufficient to effect hydrolysis) preventing gelatinization, while optically-active proteins are precipitated previously by zinc chloride, which does not affect the rotation. In applying the method to flour, potato meal, bean meal, etc., 2.5 grms. of the sample are mixed with 10 c.c. of water in a 250 c.c. casserole, the pestle washed off with 60 c.c. of calcium chloride solution (2 parts of the crystallized salt to 1 of water), 1 c.c. of 0.8 per cent. acetic acid added, and the mixture heated to boiling while agitating. After boiling gently for 15 minutes (the vessel being covered meanwhile with a watch-glass) the solution

¹ *I.S.J.*, 1919, 465; 1920, 54.

² See page 251.

is cooled quickly, transferred to a 100 c.c. flask, and the volume completed to the mark, the liquid being finally filtered through a very close paper (e.g., *S* and *S*, 605) and polarized in a 200 mm. tube. If *A* is the observed solution; *L* the length of the tube in dm.; and *S* the amount of sample used in grms., then the starch per cent. is calculated from the formula: $100 \times A \times 100/L \times 200 \times S = 50 \times A/L \times S$.

LOSS OF SUGAR OCCURRING WHEN SWEET-WATER IS USED FOR SLAKING CAUSTIC LIME.

P. Beyersdorfer. Vervins-Zeitschrift, 1921, No. 781, 75-87.

When sweet-water is used for the slaking of lime (as is quite frequently done in many factories), some of the sugar is decomposed, the amount depending upon several conditions, such as the quality of the lime and the amount of heat produced during the hydration; while in dilute solutions there is relatively more sugar destroyed than in stronger concentrations. As appears often to have been thought, caramel is not formed, at least not in appreciable quantity; but lactic and acetic acids appear to be the products of the decomposition, and also benzaldehyde if the temperature is extraordinarily high, as when the proportion of lime and water is 1:1. In regard to the conditions under which these laboratory experiments were carried out, a solution containing 26 grms. of sucrose in 500 c.c. was heated to 70°C., treated with 100 grms. of freshly burnt lime in pieces the size of a hazel-nut, carbonated at about 80°C., filtered, and the sugar in the filtrate and in the precipitate determined. Depending upon the factors already stated, especially upon the temperature resulting after slaking, the amount of sugar destroyed varied from 3.5 to 15.4 per cent. Generally in these laboratory tests, the temperature resulting did not exceed 103°C.; but in the factory it may be much higher, which leads the author to estimate the possible loss at about 20 per cent. of that originally present in the sweet-water.

RECOVERY OF THE AMMONIA EVOLVED DURING CARBONATION IN THE BEET SUGAR

FACTORY. (1) *Jar. Silhavy. (2) Jar. Hrudá. Listy cukrovarnické, 1921, 71; through Zeitschrift für Zuckerindustrie der Czechoslovakischen Republik, 1921, 45, No. 23, 155-159.*

(1) In the recent article on this subject, Prof. DONRATH¹ stated that the amount of ammonia that might be recovered from the vapours in a beet sugar factory slicing 6000 q. of roots per day is 98.6 kg. (as NH_3), or 382.7 kg. as ammonium sulphate. Laboratory experiments by Mr. SILHAVY led to the conclusion that actually the amount must be much less. Thus, 400 c.c. of juice from the diffusion battery were treated in a flask with 2 per cent. of lime (as CaO) on the roots in the form of milk at 20° Bé., and the ammonia evolved after stirring for 1½ hours absorbed by standard acid and titrated. This gave an indication of the largest possible amount that might be expected in the liming operation, and it reached only to 41.6 kg. of ammonia or 161.3 kg. of ammonium sulphate in the case of a 6000 q. factory. In order to duplicate the conditions obtained in practice more closely in regard to time, the juice was treated with the same proportion of lime at 80-90°C. during 6-7 min. only, and the liquid carbonated, the gases evolved being washed with N/2 sulphuric acid. Still less was found, the quantity being only 4.38 kg. of ammonia or 16.9 kg. of ammonium sulphate, that is about one-tenth that obtained after 1½ hour's contact with the lime. (2) A somewhat similar experiment was made by Mr. HRUDÁ, using, however, a closed, cylindrical, stirring apparatus (44 cm. diam., 55 cm. high, and having about 50 litres capacity), from which the gases were aspirated through standard acid. On liming with 2½ per cent. of lime at 80-90°C., and aspirating 30-50 mins., the total amount of ammonia obtained varied from 1.58 to 4.11 q. (as NH_3), equivalent to 6.09 to 15.92 of ammonium sulphate when slicing 750,000 q. throughout the season, that is corresponding to about 0.012 kg. of ammonia, or 0.033 kg. of ammonium sulphate in the case of a 6000 q. per day factory, a rather trifling amount. In explanation of the small yield resulting in liming and saturation, it is remarked that during these operations only the glutamin is decomposed, the asparagin being comparatively difficult to hydrolyse; while the degradation of the proteins occurs only very gradually.

¹ *I.S.J.*, 1920, 281.

Review of Current Technical Literature.

DATA CONCERNING THE FURNACES AND BOILERS OF GERMAN BEET SUGAR FACTORIES.

H. Claassen. *Vereins-Zeitschrift*, 1921, 1-12.

In order to obtain information regarding the conditions prevailing at the present time in the boiler-houses of German beet sugar factories, Dr. CLAASSEN sent out a questionnaire, and received replies that reveal useful data. Some 132 factories use ordinary bituminous coal; 124 burn brown coal¹; and 11 use both; that is 49.4, 46.5, and 4.1 per cent. of the total number respectively; or, expressing this in another way, of the total amount of beets worked in 1919-20, (i.e., 106,120,000 centners) 53.9, 40.9, and 5.2 per cent. were sliced in factories burning the three kinds of fuel in the order mentioned. An analysis was made of the location of the factories, the figures collected showing that those using brown coal are (with only a few exceptions) in the neighbourhood of the pits in the middle German and Rhineland provinces producing it. Calculated in terms of the average factory, the number of boilers is 10.1, 8.9 and 10.8; the boiler heating surface in sq. m. is 1149, 789, and 1468; and the grate area 29.8, 31.3, and 48.6 for the three fuels respectively. This for each boiler gives the heating surface as 113.8, 88.7, and 134.8; the grate area as 2.95, 3.51, and 4.50; and the ratio of boiler heating surface to grate area as 38.6, 25.3, and 30.0. Regarding the boiler evaporation per sq. m. per hour, replies on this point were received only from 183 of the 267 factories contributing to the enquiry, the average figures being 21.9, 21.8, and 19.9 for the three fuels still in the order named. Coming now to the actual coal consumption, this was found to be per 100 of roots sliced 12.0, 28.8, and 26.6 (this latter comprising 5.2 of black and 19.4 of brown coal). A number of other figures are tabulated from which one may conclude (a) that the boiler-houses using black and mixed fuel are considerably greater than those burning brown coal, the reason being that the former happen to belong to factories slicing more roots; and (b) that the heating surface of the single boilers using black and mixed fuel is also much larger than in the case of the brown coal, partly because in factories burning black coal a greater number of water-tube boilers is installed. Repeatedly the view has been expressed that plants burning brown coal require a considerably greater heating surface; but one of the results of the enquiry is to show this is not so, because the heating surface in sq. m. calculated for a factory slicing 1000 centners of roots for the three fuels is 72, 68, and 96. Nor is the assumption that the efficiency of boilers using black coal is greater than that of those burning brown, since the evaporation per sq. m. per hour is shown to be 21.9 and 21.8, as already mentioned. Other data of less general interest are reproduced, for which reference may be made to this valuable report, which contains boiler statistics of a particularly complete and valuable nature.

INFLUENCE OF THE AMOUNT OF LIME USED IN CARBONATION ON THE PURITY AND THE CALCIUM CONTENT OF THE CLARIFIED JUICE. Vlad. Staněk. *Listy cukrovarnické*, 1919-20, No. 43, 313.

When altered roots are being worked, and the invert sugar content is more than a certain small amount, the action of the lime used in clarification is to destroy the dextrose and levulose with the formation of organic acids, which are partly separated as insoluble calcium salts and partly remain in solution. In the case of only 0.1 per cent. of invert sugar, the amount present normally in beets of good quality, the alkalis liberated after carbonation are capable of precipitating the soluble calcium salts, the clarified juice then containing only about 2 mgrms. of CaO per 100 c.c. On the other hand, if the invert sugar is much greater than the amount stated, calcium salts remain in the juice and cause difficulty later, especially in working-up the lower products. After re-calling the investigations of JESSEN² in showing that 100 parts of invert sugar when decomposed give rise to about 102.2 of soluble dry substance containing 23.6 per cent. of CaO, and also

¹ Brown coals or lignites form the intermediate step between peat and ordinary black or bituminous coal; and so far as Europe is concerned are of little economical importance excepting in Germany where 68.5 million tons were raised for home consumption in 1900. It burns with a moderately long and intensely hot flame. It sluters (softens) during combustion, and cokes together, which last property seriously interferes with its usefulness as fuel.—(Editor, *I.S.J.*)

² *Österr.-Ungar. Zeitsch. Zuckerind.*, 22, 239.

after drawing attention to the work of HERZFELD¹ on this subject, Mr. STANEK describes two interesting series of experiments carried out in his laboratory. In the first, juice containing increasing amounts of invert sugar (0.1 to 0.745 per cent.) were double carbonated using 2.3 per cent of lime. Results were obtained showing very clearly that as the invert sugar content of the raw juice increases, the purity of the clarified juice decreases, while its calcium content increases. It is concluded that "it is thus certain that in a properly operated carbonation (that is, when the alkalinity at the end of the first saturation is 0.06 to 0.10, and that after the second is 0.002 to 0.005 per cent. CaO per 100 c.c.) much more calcium-organic-acid salts are precipitated in the scums than simply by saturating to neutrality." In the second series of tests, the invert sugar content of the raw juice was kept constant, viz., at 0.745 per cent., the lime being added in amounts rising from 1.3 to 3.6; but a triple-stage carbonation was made, 0.55 per cent of lime being added to the juice obtained after the first saturation, after which followed carbonation to 0.05 or 0.06 per cent. at 90°C., filtration, re-carbonation, this time to about 0.001 or 0.003 per cent., and lastly boiling. On examining the data thus collected, it was found that as the lime used was increased, so was the purity raised, while the soluble calcium content was decreased, the addition of 0.55 per cent. of lime after the first stage as indicated further increasing this effect. In the case of the invert sugar content stated, i.e., 0.745 per cent., the amount of calcium salts remaining in solution corresponded to an average amount of 90-100 mgrms. as CaO per 100 c.c.

PREPARATION OF A CATTLE FOOD FROM CPLLULOSE (SAWDUST). *E. C. Sherrard and G. W. Blanco. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 1, 61-65.*

Sawdust was treated in the same way as for the production of alcohol from wood, namely, it was digested with 1.8 per cent. sulphuric acid for 15-20 mins. under a pressure of about 120 lbs. per sq. in., sufficient water being added to raise the ratio of water to dry wood to 1:1.251, the maximum conversion of the cellulose to sugars possible in practice thus being effected. After hydrolysis, the acid liquor was removed by centrifuging, and the residue washed further with water in towers. Liquors and wash waters were almost neutralized with calcium carbonate, the sludge subsided, and the liquor evaporated to a thick syrup. The leached residue from the tower was screened, air-dried, mixed with the syrup, and the whole dried to about 12 per cent of moisture. This material, which contained 15 to 16 per cent. of sugar is said to have been fed to dairy cows "with gratifying results."

PRODUCTION OF ACETONE AND BUTYL ALCOHOL FROM STARCH BY A FERMENTATION PROCESS. *Horace B. Speakman. Journal of Industrial and Engineering Chemistry, 1920, 12, No. 6, 581-587.*

Following on the work by PERKIN² and FERNBACH regarding the synthesis of acetone, an organism has been isolated capable of fermenting potato starch with the production both of acetone and butyl alcohol. This paper discusses the seed culture methods employed in this process, using maize as the raw material, being supplementary to a previous article³ in which the essential features of the plant were outlined.

CHEMICAL INDICATORS. *H. E. Laws. Chemical Trade Journal, 1921, 68, 143.*

A list is given of the more useful sulphonephthalein indicators, showing the ranges of hydrogen on concentration which they cover.

CHEMISTRY OF CLARIFICATION IN PLANTATION WHITE SUGAR MANUFACTURE. *J. P. Ogilvie. Journal of the Society of Chemical Industry, 1921 40, No. 2, 22-24R.*

A review of recent work as exposed in the latest edition of Harloff and Schmidt's "Handleiding voor tropische Witsuikerfabricatie" and papers published by ZERNAN and others.

¹ *Deutsche Zuckerindustrie*, 1890, 274. ² *J. Soc. Chem. Ind.*, 1912, 31, 616. ³ *Ibid.*, 1916, 38, 155.

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UTILIZATION OF WASTE MOLASSES (AS FUEL, AND FOR THE PRODUCTION OF ALCOHOL MOTOR SPIRIT, CATTLE FOOD, FUEL GAS, ETC.). *H. J. Carsten. Philippine Journal of Science, 1920, 17, No. 4, 395-407.*

When using molasses as fuel by spraying it into the fire-box under pressure, it was found that the steam needed for the spraying operation amounted to about the same as that obtained by the use of this fuel. Steel ovens, in which the molasses is allowed to run over inclined plates where it comes into direct contact with the hot gases from the fire, have also been used, the molasses once ignited maintaining the fire. Admixture with bagasse has also been tried; but in most factories this practice had later to be abandoned, owing to the burning of the grates, the damage to the brickwork, and the trouble in cleaning the fire-boxes. Regarding its utilization as motor fuel, the amount of molasses produced on Negros Island is about 50,000 tons (25 per cent. of the sugar produced), which at 12 lb. per gall. (U.S.) amounts to 8,333,333 gall., capable of yielding at the high figure of 3 gall. of molasses to 1 gall. of 180 proof (American) 2,777,777 gall. of spirit. It would take 322,800 gall. of gasoline for the yearly ploughing on Negros, equivalent to 517,771 gall. of alcohol, which added to that required for harrowing should be 1,553,313 gall., leaving a surplus of 1,224,464 gall. If motor-driven pumps were used for irrigation and for conducting water to factories, the total possible alcohol production should be absorbed. Gas made from molasses requires a good deal of fuel in its manufacture, and it contains so much carbon dioxide that much lime is required for its purification. Moreover, it has very little illuminating power. Other matters considered in this paper are the solidification of molasses,¹ the preparation of "Molasenit," and the manufacture of acetate of lime² and of glycerin.³

FUTURE OF INDUSTRIAL ALCOHOL. *B. R. Tunison. Journal of Industrial and Engineering Chemistry, 1920, 12, 370-376.*

Among the useful information relating to alcohol generally given in this paper are statistical data and graphs showing the production of ethyl alcohol in the United States, Germany and France from potatoes, molasses, beets, and grain. "As far as case of manipulation is concerned, molasses unquestionably surpasses any other known material. Moreover, in the past it has been very cheap. A large proportion of the world's molasses is still a waste product, due to the difficulty and expense of transportation to the commercial centres." Among the other possible raw materials that have been proposed for the production of alcohol in America the following are mentioned: artichoke tubers (containing 14-15 per cent. of levulose and 2 per cent. of starch); sorghum (6-15 per cent. of sucrose and reducing sugars); cassava (25 per cent. of starch); cactus and agave; and fruits and fruit wastes, berries, and garbage waste. "In addition to the requirements of a sufficient supply of fermentation matter . . . , there must be also an abundant, concentrated, and stable supply of raw material. Few people realize that a small alcohol plant of even 100 gall. daily of molasses capacity will consume every day approximately 200 gall. of molasses, or 1 ton of shelled corn, or 4 tons of potatoes (about 15 per cent. of starch), or 7 to 8 tons of sweet apples (about 12 per cent. of sugar). . . . The raw material for the future production of industrial alcohol then will be determined largely by economic and local conditions. . . . For some time to come, however, in this country, molasses will probably be the most important raw material. . . . Probably the use of alcohol which in the future will have the greatest significance is as a fuel for internal combustion engines, as such, or in admixture with other compounds. . . . In about three years the peak in petroleum production will be reached, and after that time there will be a gradual decline over a long period of years. . . . At this time, the utilization of alcohol for power purposes appears very significant. . . . As the quality of the gasoline becomes poorer, and as its price rises, alcohol will be used in greater and greater quantities. . . ."

MONOPOLIES OF SUGAR IN MEDIEVAL TIMES. *E. O. von Lippmann. Die deutsche Zuckerindustrie, 1921, 46, 7-8.*

J. P. O.

¹ *Archief, 1919, 27, 932-936.*

² *I.S.J., 1919, 346.*

³ *I.S.J., 1919, 243, 340, 412.*

Review of Recent Patents.¹

UNITED KINGDOM.

CONCENTRATING FRUIT JUICES. *Barbet et Fils et Cie.*, of Paris. 153,548 (1972); addition to 135,175.² January 21st, 1920; invention date October 31st, 1919; not yet accepted; abridged as open to inspection under Section 91 of the Act.

LIDS FOR SYRUP AND CONDENSED MILK TINS. *J. F. Wright*, of Prenton, Birkenhead. 152,188 (23,348). December 18th, 1919.

A detachable cover for use with tins containing syrup or condensed milk is described. It comprises a domed part having in its upper portion a pouring opening provided with a sliding pivoted lid adapted to cut off the flow of liquid.

CHOCOLATE MOULDS. *A. A. Ballatore*, of Hyndland, Glasgow, N.B. 152,222 (28,143). November 13th, 1919.

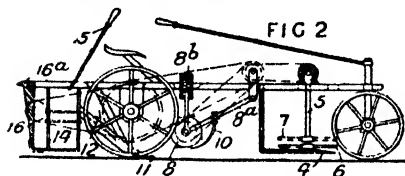
Flexible moulds for moulding chocolates are made of a gelatinous composition consisting of a mixture of gelatine and glycerin. This mixture is heated, and when about the consistency of treacle is poured into a master mould and allowed to set. After removal from the master mould, the moulded material is immersed in water at 38°C. (100° F.), immediately withdrawn, and put aside for a time until quite firm.

COATING CONFECTIONERY. *E. C. R. Marks* (*National Equipment Co.*, of Springfield, Mass., U.S.A.). 152,583 (9477); addition to 140,571 (2231). April 1st, 1920.

The machine described in the parent specification³ is modified by arranging the two conveying-means to travel in regions of different temperature, and means are provided co-operating with the tail-eliminating means to clean the same of coating material and to convey the said material to the region of higher temperature.

HARVESTING BEET. *H. C. Hansen and A. C. Andersen*, of Flaster, Denmark. 153,657 (19,512). August 7th, 1919.

A machine for harvesting beet comprises catchers 4, horizontal rotary knives 6, and arms 7, a rotary drum cutter 8, adjusting-prongs 10, root-rifters 11, and an incline 12 leading to shaking bars which clean the roots and deliver them to a receptacle 14 having



a hinged discharge door 16 provided with teeth 16^a for clearing the ground on which the roots are discharged. The machine is mounted on two front steering-wheels and two rear wheels from which the moving parts are driven. The tops are caught in an angle between the catchers 4 and are cut and thrown to one side by the knives 6 and arms 7 mounted on a vertical shaft 5. The final topping is done by the drum cutter 8 which is held down by its own weight and by springs 8^b and is adjusted by feathering curved prongs 10 mounted on the pivoted arms 8^a carrying it. The roots pass up the incline 12 to curved shaking bars which are actuated by cranks. The hinged door 16 of the receptacle 14 is controlled by a lever 15.

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

² I.S.J., 1920, 289.

³ I.S.J., 1920, 660.

Patents.

MOTOR SPIRIT CONTAINING ALCOHOL.¹ *E. C. R. Marks (U.S. Industrial Alcohol Co., of New York, U.S.A.). 153,925 (11,419). May 7th, 1919.*

A motor spirit with a freezing-point below -60°F . consists of:—(1) 40 volumes of ethyl alcohol, 28 volumes of gasoline, 17 volumes of benzol, 7.5–10.0 volumes of ether, 8 volumes of toluol; or (2) 20 volumes of ethyl alcohol, 20 volumes of gasoline, 15 volumes of kerosene, 35 volumes of methyl-ethyl-ketone, 5 volumes of ether; or (3) 15 volumes of benzol, 40 volumes of alcohol, 30 volumes of gasoline, 15 volumes of ether.

MOTOR FUEL CONTAINING ALCOHOL. *E. C. R. Marks (U.S. Industrial Alcohol Co., of New York, U.S.A.). 154,867 (28,995). May 7th, 1919.*

A motor spirit with a freezing-point below -60°F . consists of 12 parts by volume of benzol, 30 parts of gasoline, and 40 parts of absolute alcohol. Specification 153,925 (above) is referred to.

SPECIFIC GRAVITY AND LIQUID LEVEL INDICATORS. *Pneumercator Co. (Assignees of C. W. Stancliffe, of Boston, Mass., U.S.A.). 154,621 (34,104). December 2nd, 1920; convention date, June 17th, 1919; not yet accepted; abridged as open to inspection under Section 91 of the Act.*

This invention relates to apparatus for measuring the depth, volume, and specific gravity of liquid in a tank of the type in which air pressure is developed to balance the head of liquid above a reference level against an indicating column. Two pipe lines, fitted with discharge orifices submerged in the liquid at known vertical distances apart, are connected to an indicating liquid chamber provided with air pressure means and a suitably graduated indicating column.

COLORIMETER.² *A. E. Bawtree, of Sutton, Surrey. 154,671 (10,832). August 25th, 1919.*

BISCUIT MACHINES. (1) *T. and E. L. Vicars, of Earlstown, Lancashire. (1) 154,647 (16,352). June 30th, 1919. (2) 154,850 (154,853). June 30th, 1919.*

CENTRIFUGALS. (1) *H. Hooke, of Gower Street, London. 154,038 (24,708). October 9th, 1919. (2) J. McIntyre, of Portobello, Midlothian, Scotland. 154,641 (13,706). May 30th, 1919.*

EVAPORATION WITH VAPOUR COMPRESSION.³ *Aktiebolaget Indunstare, of Gotheburg, Sweden. 154,355 (21,674). September 3rd, 1919*

Evaporation is carried out in successive stages under the same temperature and pressure in evaporators in which the liquid is circulated in films and which are heated by the generated vapours after they have been compressed. Use is made of the type of evaporator described in previous specifications by the inventor,⁴ comprising vertical externally heated tubes on the interior of which the liquid is distributed in films by special devices.

DISTILLATION OF ALCOHOL. *L. Granger, C. Mariller, and Soc. Anon. d'Exploitation de Procédés Evaporatoires (Système Prache et Bouillon), of Paris. 154,558 (15,126). June 3rd, 1920; convention date, November 26th, 1919; not yet accepted; abridged as open to inspection under Section 91 of the Act.*

The condensation of vapours in apparatus for distilling alcoholic liquids, etc., is utilized to generate steam which may be used for heating or power-producing. When distilling liquids with a boiling point lower than water, the steam is generated under reduced pressure, and may be compressed.

¹ See also *I.S.J.*, 1920, 238, 477, 592, 713.

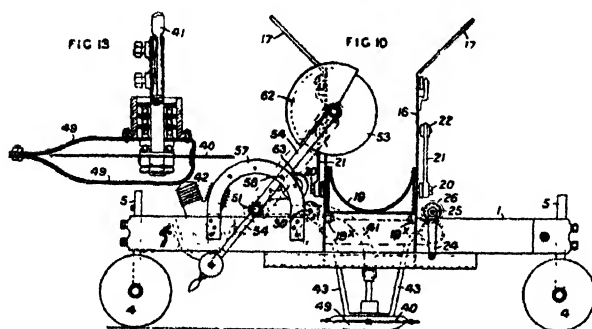
² A full description of this apparatus has already been given. See *I.S.J.*, 1920, 558.

³ *I.S.J.*, 1920, 58, 117, 418, 713.

⁴ U.K. Patents, 12,462 of 1911 and 22,670 of 1911.

CANE CUTTING MACHINE. *Max Wertheim*, of Pietermaritzburg, Natal. 156,298 (22,081). September 8th, 1919.

It comprises means for cutting the canes near the ground, for levelling and cutting off the tops, and for discharging the cut canes on to the ground. It has a timber and metal frame 1 mounted on four adjustable wheels 4, the axles of the front ones being mounted in brackets on their angular standards 5. The canes are cut by a rotary knife 40 and fall into a pivoted and approximately balanced carrier 19 in a trough 16 having a splayed upper end which may be formed of tubing 17 and woven wire. After the canes have been loosely bound, the carrier is raised and turned into a vertical position so that the top ends of the canes are levelled by contact with the bottom of the trough, after which the binding-cord is tightened. The carrier is then returned to its original position and pushed lengthwise on supporting rollers 19^x until the canes are in a position to be



topped by a rotary knife 53, which is brought down upon them. After the tops have been removed, the canes are discharged by again turning the carrier into the vertical position and releasing the binding-cord or chain. The canes are guided into the trough 16 by guide arms which are adjustable by means of cords and weights. The trunnions

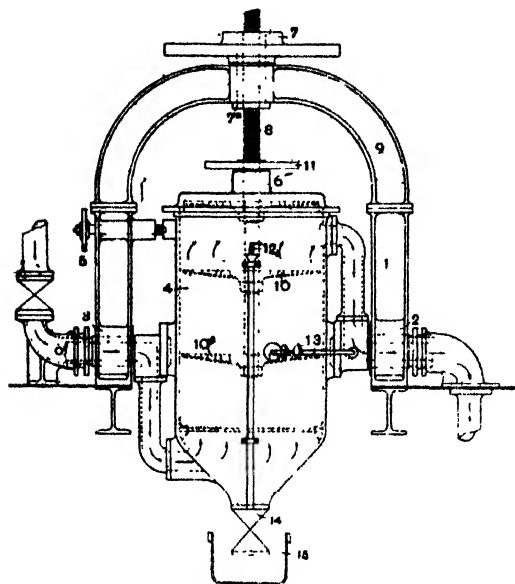
20 of the carrier 19 work in right-angled slots in the trough 16 and carry lever arms 21 which engage with rollers 22 when the carrier is raised, and turn it into the vertical position. The carrier is raised by means of ropes or chains wound on drums 26 on shafts 25, 30 which are connected by spur and chain gearing and are operated by a handle 24. The cutter 40 is driven by flexible shafting 41 and a clutch from a shaft 51 driven by chain gearing from an engine 42, which is cooled by means of a fan 63. The cutter 40 is manipulated by means of handles 43 and is provided with a casing 49 and with ball bearings. The topping-cutter 53 is mounted in ball bearings carried by a pivoted and counter-weighted arm 54 which may be held in position by a segment 57 and pin 58. The cutter 53 is driven by chain gearing and a clutch from the shaft 51, and is provided with a casing 62. The machine may be propelled by the engine 42, or drawn by animals. The carrier 19 may be operated by power from the engine. Two or more carriers may be employed. In a modification, the machine has six wheels, the central pair of which is replaceable by others of different size, the carrier is raised by means of racks and pinions, and the topping-cutter is movable laterally and is adapted to be thrown back from operative to inoperative position by means of a handle pivoted on its shield.

MANUFACTURE OF A PRECIPITATE (FOR FEEDING STUFF) FROM BEET RAW JUICE AND AFTER-PRODUCTS. *M. von Wierusz-Kowalski*. 132,798. September 16th, 1919; convention date, July 11th, 1916; complete accepted, December 16th, 1926.

Raw beet juice is heated to about 80–100°C., treated with sulphurous acid to give an acidity of 0.01–0.02 per cent., when a flocculent precipitate results. After adding lime (or other alkali) until the reaction is 0.2–0.4 per cent., the juice is filtered. A precipitate containing 20 per cent. of albuminoid substances and 5 per cent. of phosphoric acid (on the dry substance), and an ash content less than 10 per cent., is said to be thus obtained. "It can thence be used successfully as a food rich in albumin" It is stated that "waste liquors" may be treated in the same way.

FILTER, USING BAGASSE OR LIKE MEDIUM. *James Miller and George Fletcher & Co., Ltd., of Derby.* 158,387 (27,519). November 7th, 1919; February 7th, 1921. (One drawing.)

A frame 1 has trunnions 2, 3, adapted to carry a pivoted filtering chamber 4 fed through the hollow trunnion 3 and exhausted through the hollow trunnion 2. A stop 5 may be provided to maintain the filter chamber in its normal position of operation, which in use is swung about trunnions 2, 3, to receive a charge of bagasse or the like filtering



medium. It is then moved into the position shown in the drawing and the cover 6 is lowered on to the top of the chamber 4 to close this by rotating the internally threaded hand-wheel 7 mounted on the screwed spindle 8 which hand-wheel has collar 7^a mounted to rotate within the yoke 9. When the cover 6 is bedded upon the top of chamber 4 further rotation of the hand-wheel 7 will commence to move down a follower 10 until it contacts with the mass of bagasse of the chamber 4. This follower 10 can be locked in this position by the hand lock nut 11. The stock to be filtered can then be allowed to pass into the chamber 4 through the hollow trunnion 3, so that in bringing the filter into and out of operation no pipe joints for the sugar stock are broken. This stock will filter

through the chamber 4 and pass out through the hollow trunnion 2. Should the medium passing through the filter become muddy, extra pressure can be applied to the bagasse or the like by means of the hand-wheel 7 bringing the follower down into, for instance, the position shown at 10^a in the drawing. A test cock 12 can be provided on the chamber for testing the level of the liquid in it, and the chamber can also be provided with a pipe and stop cock 13 for drawing off all liquor lying above the follower pressing on the filtering medium when in its lower position prior to emptying the chamber of its bagasse or the like filtering medium. By this means waste of sugar liquid is avoided. A stop cock 14 can be provided at the base of the chamber 4 to draw off the mud or sediment into the channel 15, which may also receive liquor from the test cock 12, whereby all waste is prevented.

COCOA-BREAKING MACHINE. *J. Baker & Sons, Ltd., and W. E. Prescott.* 155,320 (18,721). July 28th, 1919.

It comprises three toothed rollers disposed with their axes in three superimposed planes, one of the rollers of the upper pair being of general oval form and section, so that during rotation of the rollers the width of the space between the upper pair is periodically varied.

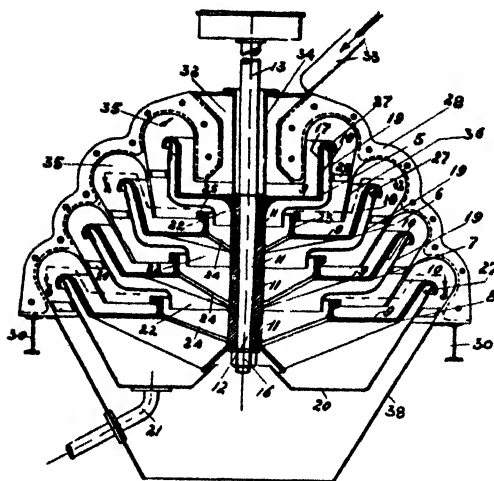
CENTRIFUGAL MACHINE, ELECTRICALLY-DRIVEN. *A. Melotte, of Remicourt, Belgium.* 156,070 (22,313). July 27th, 1920; convention date, December 26th, 1919; not yet accepted; abridged as open to inspection under Section 91 of the Act.

A machine is described, the suspended bowl of which is driven by an electric motor located in the head of the apparatus.

UNITED STATES.

CONTINUOUS CENTRIFUGAL MACHINE. *Joseph Avrutik*, of New York, U.S.A. 1,360,708. November 30th, 1920. (Three figures.)

In centrifuging massecuite it is found after the operation that the layers nearest the centre are less well separated than those most remote, which latter have in fact been subjected to a greater force. According to this invention, the massecuite is centrifuged successively in a series of drums, 5, 6, 7, and 8, being fed from one to another of progressively greater diameter. Thus, the massecuite is introduced in a continuous stream into basket



5, in which a separation of syrup through the perforated wall 10 occurs. Centrifugal force causes the massecuite remaining to pass over the side of drum 5, and fall into drum 6 below, and so on. Each time the massecuite is transferred to another drum, its constituents are re-arranged, the less well separated portions being mixed with the rest. Drums 6, 7, and 8 are successively larger than drum 5, as shown, and their walls are increasingly inclined in order to facilitate the passage of the gradually purified massecuite. After leaving drum 8, the crystals go into discharge hopper 38, from which they are discharged. In regard to the syrup separated from each of the drums, this passes into the receiving pan 19,

finally reaching pan 20, from which it is drawn out of the apparatus through pipe 21. In this way, it is seen that the massecuite in the uppermost basket 5 is subjected only to a moderate separating force. The substance having been divested of a portion of its liquid content, its constituents are re-arranged and subjected to a greater force. These two modes of operation, namely, the re-arrangement of the constituents of the substance, and its subjection to a progressively greater force, are continued until no liquid remains in the substance. By this method of removing the liquid content from the substance, all the solid particles are equally subjected to the liquid-removing force.

MOTOR FUEL CONTAINING ALCOHOL. *Albert Hayes*, of New York, N.Y. (assignor to U.S. Industrial Alcohol Co., of West Virginia, U.S.A.). 1,361,153. August 27th, 1919; December 7th, 1920.

Alcohol and kerosene should produce a satisfactory combination for an explosive mixture (it is considered) were these two liquids miscible; and in order to overcome this difficulty the inventor proceeds in the following way: One part of ether is mixed with 14-16 of kerosene (or other petroleum distillate preferably heavier than gasoline or petrol, though the latter may be used); 7-20 parts of benzol added; and lastly 9-70 parts of alcohol added to the whole, a motor fuel mixture in which the various components are in solution thus being obtained. Alcohol containing 5 per cent. "or even more" of water may be used, being found to blend readily with these components.

BEEF TOPPER. *Samuel J. Wilson*, of Great Falls, Mont., U.S.A. 1,369,721. January 11th, 1919; February 22nd, 1921.

BEEF HARVESTER. *Rikizo Ariuchi*, of Kerry, Oreg., U.S.A. 1,369,373. September 24th, 1919; February 22nd, 1921.

Patents.

BET HARVESTER, MOTOR DRIVEN. *Olof Frankman*, of Malmo, Sweden. 1,371,360. October 25th, 1919; March 15th, 1921.

CONFECTIONERY MACHINERY. (1) *Frank Locorotolo*. 1,370,027. May 29th, 1920; March 1st, 1921. (2) *Charles M. Becker and Herman Becker*, of Brooklyn, N.J. 1,369,772. May 10th, 1920; March 1st, 1921.

CANDY AND OTHER FOOD PRODUCTS. *William F. Speck*, of Chicago, Ill., U.S.A. 1,371,450. March 13th, 1919; March 15th, 1921.

CENTRIFUGALS. *Nelson H. Norris*, of Renfrew, Ontario, Canada. 1,371,259. April 19th, 1920; March 15th, 1920.

FLUSHING APPARATUS FOR USE WITH PRESSURE FILTERS. *Louis J. Martel*, (Assignor to *Martel Filter Co., Inc.*, New Orleans, La., U.S.A.) 1,370,469. March 11th, 1920; March 1st, 1921.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

EVAPORATION OF FRUIT JUICES. *E. Barbet et Fils et Cie.* 135,175 (27,401). November 9th, 1918.

CHOCOLATE MANUFACTURE. *Sarotti Chokoladen & Cacao-Industrie A.-G., and A. Muller* 159,885 (7016). March 10th, 1920.

MACHINE FOR CUTTING SUGAR. *Soc Anon. Raffinerie Tirlemontoise.* 159,899 (7589). March 10th, 1920.

HYDRATION OF LIME. *E. R. Sutcliffe.* 160,556 (32,144). December 22nd, 1919.

PRODUCTION OF FERMENTED LIQUORS. *C. S. Townsend.* 160,562 (32,245). December 22nd, 1919.

CONFECTIONERY MANUFACTURE. *N. E. Brigham.* 160,700 (15,720). June 10th, 1920.

CONVERSION OF WOOD INTO SUGAR. *By S. F. Acree.* 160,776-160,777 (8492-8493).

REFINING APPARATUS FOR TREATING COCOA BEANS. *E. C. R. Marks (National Equipment Co.).* 161,210 (27,120). November 4th, 1919.

CELLULOSE FERMENTATION. *Power Gas Corporation, Ltd., and H. Langwell.* 161,294 (694). Addition to 134,265. January 8th, 1920.

RECTIFYING APPARATUS. *E. Barbet et Fils et Cie.* 138,869 (3707). February 8th, 1919.

FILTERING APPARATUS. (1) *Dorr Co.* 139,493 (5714). October 5th, 1918.

(2) *L. C. Davis.* 161,509 (31,260). November 4th, 1920.

LIQUID FUELS. *U.S. Industrial Alcohol Co.* (1) 140,797 (8797). October 12th, 1917.

(2) 133,709 (24,852). November 28th, 1917.

GLUCOSE MANUFACTURING FROM WOOD. *M. Levy and H. Terrisse.* 143,212 (12,609). May 13th, 1919.

BEARINGS FOR CENTRIFUGAL MACHINES. *Baron von Bechtolsheim.* 147,096 (19,123). May 30th, 1919.

PACKING SUGAR BLOCKS. *Soc. Anon. Raffinerie Tirlemontoise.* 161,567 (8151). April 20th, 1920.

FILTER PRESS. *H. A. Vallez.* 161,193 (10,177). March 6th, 1915.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING APRIL 30TH.		FOUR MONTHS ENDING APRIL 30TH.	
	1920. Tons.	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS.				
Germany	3,956	....	4,738	....
Netherlands .....	....	250	....	595
Belgium .....	....	....	....	....
France .....	....	....	....	....
Czecho-Slovakia .....	....	....	....	....
Java .....	....	5,332	389	21,826
Philippine Islands .....	....	....	....	....
Cuba	119,432	75,956	215,402	87,857
Dutch Guiana .....	....	....	....	638
Hayti and San Domingo ..	....	....	....	....
Mexico .....	....	....	....	....
Peru	1,879	8,004	18,649	49,088
Brazil	566	704	5,594	24,610
Mauritius	12,845	44,997	90,161	111,275
British India	1,536	....	2,775	....
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	23,514	12,790	36,541	36,077
Other Countries	399	13,362	11,246	27,278
Total Raw Sugars.....	164,127	161,395	415,494	359,245
REFINED SUGARS.				
Germany .....	....	....	125	1
Netherlands	23	17,123	995	35,401
Belgium	210	5,560	705	16,043
France	1	926	2	2,530
Czecho-Slovakia .....	....	....	19	138
Java .....	....	99	5,007	101
United States of America ..	10,664	7,131	66,678	12,698
Argentine Republic.....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	210	17,844	7,534	36,076
Total Refined Sugars ..	11,108	48,682	81,065	102,988
Molasses	3,726	5,371	35,807	25,693
Total Imports.....	178,960	215,448	632,366	487,926

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .....	....	....	....	....
Netherlands .....	....	381	2	1,038
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	2	131	89	531
Canada .....	....	....	....	....
Other Countries	2	147	9	884
FOREIGN & COLONIAL SUGARS.	4	660	99	2,453
Refined and Candy.....	180	39	656	53
Unrefined	3	5	1,236	514
Various Mixed in Bond....	....	....	....	....
Molasses	432	102	1,261	293
Total Exports.....	619	806	3,252	3,313

Weights calculated to the nearest ton.

United States.

(Willott & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920 Tons.
Total Receipts January 1st to April 28th		914,476	1,124,829
Deliveries		908,369	1,124,829
Meltings by Refiners		781,186	965,199
Exports of Refined		65,000	160,000
Importers' Stocks, April 28th		18,159	none
Total Stocks, April 28th		176,191	85,261
		1920.	1919.
Total Consumption for twelve months		4,084,672	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

	(Tons of 2,240 lbs.)	1918-19 Tons.	1919-20 Tons.	1920-21 Tons.
Exports		929,435	1,307,086	767,010
Stocks		778,075	669,330	776,224
		1,707,510	1,966,416	1,543,234
Local Consumption		30,000	24,500	30,000
Receipts at Ports to March 31st		1,737,510	1,990,916	1,573,234

Havana, March 31st, 1921

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR FOUR MONTHS ENDING APRIL 30TH, 1913, 1920, AND 1921.

	IMPORTS			EXPORTS (Foreign).		
	1913. Tons	1920 Tons	1921. Tons.	1913. Tons	1920. Tons.	1921. Tons
Refined	257,090	81,065	102,988	379	656	53
Raw	320,077	415,494	359,245	1,017	1,236	514
Molasses	45,165	35,807	25,693	91	1,261	293
	<u>622,332</u>	<u>532,366</u>	<u>487,926</u>	<u>1,487</u>	<u>3,153</u>	<u>860</u>
				HOME CONSUMPTION.		
			1913 Tons.		1920. Tons.	1921 Tons.
Refined			247,800		92,246	95,698
Refined (in Bond) in the United Kingdom			232,735		220,405	316,159
Raw			35,307		108,398	41,273
Molasses			10,330		14,282	3,739
Molasses, manufactured (in Bond) in United Kingdom ..			13,786		26,717	17,049
Total			539,958		462,048	473,918
Less Exports of British Refined			8,836		99	2,453
			<u>531,122</u>		<u>461,949</u>	<u>471,465</u>

Sugar Market Report.

Our last report was dated 6th April, 1921.

In sympathy with foreign influences, the general trend of the home market has been downward, and the active conditions last reported have given place to a period of dullness and difficulty of trading.

There are no present signs of an early settlement of the coal strike, which came at an inopportune moment for those who had been led by returning confidence to purchase rather freely for early requirements. The pooriness of the demand and the pressure of arrivals resulted in some re-sales by users and distributors and tended to create a distrust in ruling values, which has been justified by the fall which has taken place. The London refiners have reduced their prices to-day by 2s., making totally 6s. per cwt. in the last month; Tate's No. 2 Granulated is now quoted 63s. 6d., and No. 1 Cubes, 68s., duty paid. American Granulated, which had been sold up to 41s. c.i.f. arrived Liverpool, has been persistently offered at declining prices, and has been done to-day at 33s. c.i.f. arrived London. Polish Granulated on the spot is offered at 59s., and J Dutch sold at 62s. duty paid. West Indian Crystallized quoted 57s to 59s. 6d. spot, according to quality.

Business in the terminal market has been disappointing, and confined to small operations mostly in minimum quantities; October-December is offered at 19s. 6d., although this is below the parity at which any 96° sugar can be purchased and placed on the spot in bonded warehouse as cover for such a sale.

Reports from Cuba point to satisfactory crop progress, and although financial conditions are still unsettled, the recently completed arrangements for obtaining a credit to finance the sugar stored in Cuban warehouses have helped to strengthen confidence and to remove doubts which existed as to whether full grinding of the crop would be accomplished. The Selling Committee has continued its operations at declining prices, and to-day's limit of 3½ c. per lb. compares with 5¼ c. a month ago. Sales included 20,000 tons to the United Kingdom at 26s. 6d. c.i.f., equal to 4.56 c. c. & f New York. There are 195 Centrals grinding, against 162 last year; total receipts to 30th April, 2,163,000 tons, and stock 1,107,000 tons, compare with 2,570,400 tons and 672,000 tons respectively a year ago.

Calculations are published which point to a possible final outturn of about 3,700,000 tons, provided that the crop can be fully ground. However satisfactory this may be to the grower, the task of marketing the sugar remains to be faced, and the prosperity of this operation must depend largely upon the course of consumption, or such return to stable conditions generally as will inspire confidence amongst buyers. Certainly there is little inclination in any part of the world to enter into stocks at the moment, which is not surprising with production going on apace for everybody to see.

There are signs of a certain amount of resistance on the part of Cuban sellers, quite natural after such a severe fall, and probably due to the improved demand which is reported from United States buyers.

The Java market has been dull and quotations are lower. The Syndicate price has been reduced to 17½ guilders f.o.b. for Whites. Working on the New Crop has commenced, and it is said that an increase of about 150,000 tons over last year is looked for. The demand for India remained dull until a few days ago when a moderate business was done in May at 30s., June 26s., c. & f. Calcutta. Stocks in the Indian ports are still low, and sugar actually on the spot commands a premium of about 10s. per cwt.

Continental weather reports are mainly satisfactory, and although no definite information is yet published regarding the extent of sowings, current ideas favour an all-over increase of something below 15 per cent. These include Germany at 12 to 15 per cent., Czechoslovakia 5 per cent., Belgium 15 per cent., and Holland 10 per cent. For France no figure is given, whilst Denmark will probably show a reduction of about 5 per cent. The present crop in Italy is turning out short of the 170,000 tons estimated, and it is said will not exceed 145,000 tons, which points to that country requiring to make further purchases for near shipment.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
May 6th, 1921.

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✂ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Trade Stagnation at Home.

The coal strike has continued now eight weeks and at the moment of writing is still unsettled, though there is a growing conviction that another week or two of negotiations will result in some settlement such as will allow the miners to return to work. Mr. LLOYD GEORGE remarked the other day that the country was strangely apathetic to the outcome; the reason for this is ascribed to the slackness of trade generally, and to the inability of manufacturers to quote for any orders while the cost of production (as regards the coal supply and its price) remains unascertainable. Better, it is thought, to have a belated settlement that will be of a permanent character than a hurried agreement that will lead to a further stoppage after the wheels of industry have once more got going. So there is not the pressure to solve the impasse that at other times might be forthcoming. But once a permanent settlement is come to, it is believed that trade will revive generally.

The sugar machinery trade is probably one of the least affected by the slump in general trade; but eight weeks of idle coal mines has deprived practically all industrial concerns of the means to carry on, save where oil fuel could be procured and utilized. What coal could be obtained, either by importation or from isolated stocks and mines, has naturally been commandeered for national utility purposes and domestic requirements. Railway travelling (apart from suburban services) is more reminiscent in its tediousness and discomfort of fifty years ago than of the 20th century. That things are not worse is due in a considerable measure to the ability to substitute oil for coal and probably there will never in the future be such a dependence on coal for industrial purposes. But coal is after all the principal raw material of this country and the mainstay of the export trade; so it would be calamitous if its production and sale could not soon be placed on an economic basis once more, and we had to fall back largely on an imported liquid fuel.

Meantime the production of manufactured goods in this country suffers a serious if temporary setback, and it may be assumed that amongst them deliveries of much needed sugar machinery made in this country for the colonies and elsewhere will be seriously delayed in delivery. But in the end if the coal mining

industry can through the settlement of their present dispute be led to settle down to steady production for some years, much will have been done to quicken and then stabilize the wheels of production, and contracts can be entered into with more certainty of fulfilment than has been the case since the Armistice.

The Sugar Supply.

As regards the sugar supply at home during these abnormal days, the position of the British refineries appears to have improved slightly since last month. Although the Greenock houses are still closed for lack of fuel, the Liverpool ones have managed to re-start the last few days (either with imported coal or with oil fuel), while the big London refineries have managed to keep going during the whole of the strike, and are supplying small amounts of sugar regularly to the dealers. As a consequence, the strike-diminished demand of the consuming population is being met without difficulty, all the more as there is no lack of foreign sugar (chiefly American) available to meet any shortage.

The States appear to be faced with a big surplus that was estimated a month ago by the *Federal Reporter* at no less than 1,000,000 tons: excess American refined, say, 330,000; American beet unsold, 400,000; raw sugar in American ports, say, 270,000 tons. Americans are therefore keen on finding an outlet for this surplus, since it would need an American consumption of 5,000,000 tons for 1921 to absorb the probable supply, whereas the actual consumption is not expected to exceed 4,000,000. But the disastrous strike in this country, which may yet last a month longer, does not encourage the belief in any large consumption over here for some months; the working classes are earning too little to be able to indulge in any liberal diet of sugar. What our 1921 consumption is likely to be it is hard to forecast, but 1,200,000 tons is, at a guess, a likely maximum figure. Trade will only slowly recover from the lack of coal, and even the coal miners will not all find work when the strike is over, since they have allowed a considerable number of mines to get damaged; hence unemployment will be bound to be prevalent for a good while to come, all of which will be reflected in reduced purchases of sugar.

The Americans are, however, not the only sugar holders anxious to dispose of their surplus in this country; certain Cuban interests are over in London trying to dispose of a quantity of the present Cuban crop in the United Kingdom. So far no news of a deal has been published; but with plenty of sugar available from other sources, it is not likely that there will be any hurry to accept the Cuban offers unless the price is particularly favourable and the refineries can take further supplies of Cuban raws in the near future; in any event, the latter are supposed to have enough raws to meet their needs till August or September.

The Trinidad Crop.

Messrs. EDGAR TRIPP & Co., of Trinidad, in their April report of the sugar industry of that island remark that the occurrence of unlooked for rain throughout the dry season has led to much difficulty and unusual delay in harvesting, and serious fears are now entertained that it will be impossible to reap the full crop before the wet season sets in in earnest. Should this fear be realized, it would be most unfortunate, especially if among the canes left over were any substantial quantity from the cane farmers in whom it is so desirable that confidence should be established as to the ability of the factories to deal with any increasing cultivation, weather conditions notwithstanding. It points also to the urgent necessity of confidence on the part of the sugar estate proprietors that preferential relations

Notes and Comments.

with the Colonies will become part of the permanent policy of the United Kingdom. Until that confidence is justified, no very large investment in extended and improved factories is likely. As it is, the manufacturing plant is only just large enough to comfortably handle existing crops in fine weather. The young cultivation, it may be added, never looked better, and—froghoppers permitting—the crop of 1922 should be a bumper one.

The Prospects of Continued Imperial Preference.

As regards the political question raised above by Messrs. TRIPP, our opinion is that so long as the Government at home is in the hands of the present combination of parties, the preferential relations are certain to continue. A Labour Government might be inclined to drop the preference if thereby they could aid the "free breakfast policy" or its equivalent; though even Labour men are slowly tending to become protectionist. An independent Liberal Government would probably be as ready as of old to sacrifice the Colonies to their free trade fetish, but much depends on the *personnel* of such a party, which to some extent too would partake of the nature of a coalition.

But of these two parties, unfavourable in their tenets to the Imperial preference, the Independent Liberal or "Wee Free" one, as it is popularly called, does not stand in the near future any chance of commanding the approval of the country while it maintains almost unimpaired the political views held by it before the war; for it is a safe proposition to assert that the bulk of the population of this country have as the result of the war broadened their views in the matter of national economics, and while not prepared to assent in a hurry to any radical change are yet prepared to consider any reasonable departure from pre-war policy such as the changed conditions of the present day seem to warrant. The bulk of them if not yet converted are at least open to argument, which was more than could be said of many of them before the war. If the Independent Liberal leaders do secure the Government of the country, it would be due to unexpected cross-currents of national temper calling for a change, rather than any conviction that the "Wee Frees" are the ideal mouthpiece of the country at large.

There is more chance of the alternative Government being a Labour one, because Labour can command very considerable voting strength in the populated centres of the country. But recent events connected with the succession of strikes have done nothing to refute the dictum of Mr. WINSTON CHURCHILL that Labour is not yet fit to govern. So long as, to borrow a military parallel, the Labour army is controlled in a crisis not by the comparatively experienced views of the staff officers, but by the localized ideas and narrowness of outlook of the corporals who tend to dictate what headquarters shall or shall not do, so long would a Labour Government be merely the puppets of a group of extremists amongst the rank and file who would be the real rulers, although least fitted by practical experience and breadth of outlook to hold the reins of Government. Probably, however, the bulk of the working classes will by now be increasingly aware of this, and will hesitate to put into constitutional power a set of men whose position in the counsels of the labour party is due more to their energy plus the apathy of the more moderate type of man to record his views, than to any real ability to represent the latter. Were trade union ballots made secret, as are parliamentary ballots, there would be more hope of a really reasonable Labour Government offering, and more chance of the country putting one into power some day soon. As it is at present, these chances are being spoilt by the extremists in their fold, and the position in power of the present Coalition government correspondingly strengthened.

The Australian Sugar Production.

The Commonwealth Minister of Customs¹ has announced that the Commonwealth Government will continue to pay Australian sugar growers £30 6s. 8d. a ton for raw sugar during the current year, and the refined product will be sold to distributors at £49 a ton, the retail price being 6d. per lb. A heavy crop is expected this season, but it will not be available until the end of the year. If it fully meets Australian requirements, a reduction in price is possible in 1922.

The net result of the Commonwealth Government's transactions in sugar, taking all liabilities into account, was a loss or deficit on 30th June, 1920, of over £900,000, and it was found necessary to increase the amount which the Treasurer was empowered to borrow from the Commonwealth Bank to £1,000,000. It is hoped that by 1st of August the losses on the sugar account will be overtaken. The sugar imports in 1918-19 were 52,569 tons, of the value of £1,052,124, or a little over £20 per ton; in 1919-20 the quantity was 112,805 tons, of the value of £4,359,203, or £38 12s. 9d. per ton. For 31st December, 1920, the imports were 24,475 tons, valued at £1,059,342, or a little over £45 5s. per ton. It is hoped that the 1920-21 season's crop from Queensland will be sufficient for the whole of Australia, and so save the people the extra cost of bringing in the high costing product from abroad.

A New Method of hauling Cane.

A rather interesting method of hauling cane from the fields (based on a system that has been applied in other transport industries) has been lately tried out in Cuba by Mr. D. R. THOMAS, of Havana (according to the *Cuba Review*). It consists of a motor truck *chassis* with two removable bodies, of which one can be in transit with its load while the other stands in the field and is filled up with cane. Thus the motive power is in continuous service, and the "dead time" during which the body is being loaded is eliminated from its schedule. Obviously by this means one motor can do the work of transporting two or even more loads of an ordinary motor truck, depending on the distance to be traversed between the cane cutters and the railhead or factory. The Thomas cane body consists of a platform mounted on four collapsible legs, which are hooked to the underside when the truck is travelling. The truck is equipped with a device placed directly behind the driver's seat which raises the body in position to be loaded, and lowers the body on to the truck when loaded. The platform is fitted with the usual stanchions for holding the bundles of cane. As for the *chassis*, it is fitted with wheels equipped with special hauling rims that give 8 in. bearing surface per gross ton load; these special rims come into play only when the truck is operating on soft ground, the regular rubber tyres coming into use when travelling on stone roads; thus speed is not sacrificed, and no change of rim is required. The cost of the motor truck with two bodies, f.o.b. Havana, is put at \$4000, while additional bodies cost \$300. The cost of moving 100 arrobas [2536 lbs.] 1 kilometre [0.62 miles] with a 2-ton outfit is said not to exceed 30 cents [say, 1s. 9d. per long ton-mile], and with a 5-ton outfit 25 cents.

This method of using several bodies to one motor outfit is, as we said above, not new; but we think it is the first time it has been tried in the cane fields, and it promises to prove a useful innovation resulting in a great saving in cost of transport in all cases where rail-less motor traction can be used in the fields. In Cuba its substitution for the time-honoured ox cart or "carreta" should speed up

¹ Vide *Board of Trade Journal*.

Notes and Comments.

operations in an industry that has always there made a point of hustling the work during the grinding season.

The New Trinidad Customs Tariff.

The Customs Duties Ordinance (No. 8 of 1921) of the Trinidad Government, which was assented to on April 1st last to give effect to the terms of the Canada-West Indies Trade Agreement, 1920, so far as they relate to the Colony of Trinidad, provides for a preference on British goods. In our particular sphere it is to be noted that sugar machinery of British origin is to be admitted free, while a 5 per cent. *ad valorem* tax is imposed on machinery of other origin. There is also a duty on imported sugar; British refined pays 2s. per 100 lbs. and other refined 4s.; the figures for unrefined are respectively 1s. 6d. and 3s. Agricultural implements, as contrasted with agricultural machinery, are admitted free in any case, as are manures, fertilizers and insecticides, and scientific apparatus.

One is glad to see that the principles of Imperial preference are being extended, and are not being confined to a preference on sugar imported into the Mother Country; our only complaint would be that the *ad valorem* duty is, if anything, on the low side, and does not compare with the duties levied in protectionist countries, which run to anything up to 40 per cent. We do not advocate the latter figure, but a 10 per cent. minimum would certainly be more reasonable. After all, the preference on Trinidad sugar coming to this country is 16½ per cent.

The European Beet Sowings 1921.

MESSRS. F. O. LIGHT'S ESTIMATE.

	1921-1922.		1920-1921.
	HECTARES		HECTARES
Germany	330,000	....	278,652
Czecho-Slovakia	205,000	....	196,000
France	91,000	....	81,840
Netherlands	69,000	....	63,468
Belgium	58,500	....	53,052
Sweden	47,600	....	45,387
Denmark	34,000	....	38,600
Hungary	34,500	....	22,523
Italy	70,000	....	46,000
Austria	6,800	....	4,796
Other countries save Russia	179,000	....	167,014
	<u>1,125,400</u>		<u>997,332</u>

Russia, Poland, Ukraina, not estimated. The increase for Europe, excluding the areas constituting the former Russian Empire, thus amounts to 12·83 per cent.

Regarding the difference between the direct polarization and the sucrose per cent. by double polarization (Clerget) in the case of beet molasses, E. SAILLARD¹ points out that in dry seasons when the total nitrogen content is high, this is relatively small (being about 0·53 per cent. in 1911). On the other hand, during normal campaigns, the difference is greater (averaging 1·45, and reaching 2 per cent. in 1913). These optically-active nitrogenous substances are levo-rotatory in alkaline solution, and dextro-rotatory in acid solution, their effect being to diminish the direct polarization, which then approaches more closely to the result obtained by double polarization.

¹ *Circ. hebdomadaire. Syndicat. Fabr. Sucre France*, 1920, 32, 222.

Fifty Years Ago.

From the "Sugar Cane," June, 1871.

In this issue was published a paper by C. HAUGHTON GILL on the action of basic lead acetate on invert sugar, which is now regarded among chemists as a classical contribution. He showed that if a solution of invert sugar be polarized in the presence of basic lead acetate solution, its levo-rotation is diminished to a marked extent, so much so that it may actually become dextro-rotatory, if sufficient be added. Thus if 15 c.c. of a solution of invert sugar be made up to 50 c.c. with (a) water alone; with (b) 2 c.c. of basic lead acetate and water; and (c) with basic lead acetate alone, the readings obtained are (a) -28.25 ; (b) -24.7 ; and (c) $+57.0$. These results revealed an important source of error in the determination of sucrose in sugars, either by direct polarization, or by the Clerget or double polarization method. "Now when a sugar solution containing invert sugar is clarified by basic lead acetate . . . the first direct reading is too high. When the liquid is acidified and inverted by heat, the original invert sugar has its true levo-rotatory power restored, and added to that of the invert sugar proceeding from the cane sugar, thus producing a greater 'difference' in the readings than that due to the cane sugar alone, and consequently leading to too high a result . . ."

Following the reading at the Society of Arts of the paper on the diffusion process in the cane sugar factory,¹ the lecturer, FERDINAND KOHN, referred to a process of fermentation in motion. "The saccharine juice . . . was conveyed into a battery consisting of six or eight fermenting vats all connected together, the top of one being on a level with the bottom of the other, in the same way as Schützenbach's macerator, and fermentation thus went on while the liquor was in motion Modern experiments had proved that . . . the liquor fermented more rapidly when in motion, 12 hours only being required for the fermentation of the beetroot liquor, whereas under the old process from three to six days were required for the same purpose . . ."

Article II of the Sugar Convention of 1864 provided that immediately after the ratification of the Convention steps should be taken for making practical experiments in the refining of raw sugars of each class and of different origins to determine the real yield of each, by the results of which the provisionary yields which had already been suggested should be modified. The duty of conducting these experiments had been entrusted by the Convention to M. BARBIER and Mr. OGILVIE, the French and British commissioners respectively; and 400 tons of four classes of sugars of various origins were worked up in a refinery in Cologne under their direction. In this issue of the "Sugar Cane" are reported in detail the average yields obtained, following the publication of which results a declaration was signed in Paris by the representatives of the four powers concerned fixing the minimum yield per 100 kg. of raw sugars as under:

DUTCH STANDARD NO.		YIELD OF REFINED LOAF.
18-15	.....	94 kg.
14-10	.....	88 „
9-7	.....	80 „
Below 7	.....	67 „

¹ I.S.J., 1921, 248.

Notes on American Beet Sugar Production.

(By our American Correspondent.)

It is something of a paradox that the past season, which was the most successful in the history of the beet sugar industry in the United States judged by the volume of production, should have been at the same time one of the most disastrous in its financial results. Few of the beet sugar companies will show anything substantial in the way of net earnings when their output is finally sold. Many of them will have accumulated heavy deficits, and one or two of the newer companies will be unable to operate during the coming season because of the financial difficulties under which they are labouring.

The final returns in the matter of production are now in. They show a total yield of sugar amounting to 1,090,121 short tons. The ton of 2000 lbs. is regularly used in statistics of the American beet sugar industry, but for the convenience of your readers this and succeeding figures will be given in equivalent long tons. In these terms the production for the past five years has been as follows:—

	LONG TONS.					
1920-21	973,322
1919-20	648,617
1918-19	680,745
1917-18	683,220
1916-17	732,739

From the above figures it will be seen that the crop of the past season was some 240,000 long tons larger than the highest previous output, which was reached in 1916-17. During and immediately following the war the high prices commanded by cereal crops, which regularly compete more or less strongly with sugar beets for the farmer's attention, prevented the expansion of sugar production. The larger output attained during the past season was due both to an increase in the acreage devoted to beetroot and to unusually favourable weather conditions for the making of the crop. Ninety-eight beet sugar factories were in operation last season, a larger number than in any previous year.

The generally favourable results obtained during the past year in yield, sugar content, extraction and purity, as compared with the preceding season, are shown by the following table:—

	1920-21.		1919-20.	
Acres harvested	872,376	..	692,455	..
Beetroots worked (tons of 2000 lbs.)	7,999,221	..	5,887,557	..
Yield per acre (tons of 2000 lbs.)	9.17	..	8.50	..
Per cent. sugar in roots	15.96	..	14.48	..
Per cent. sugar extracted	13.63	..	12.34	..
Average purity co-efficient	83.71	..	82.84	..

The average price paid to growers for the beetroots during the past season was \$11.63 per ton of 2000 lbs. as compared with \$11.74 in the preceding year, but the net return to the grower was much greater during the past season on account of the higher average yield. The total amount paid to growers for their roots was approximately \$100,000,000 (£20,000,000), and, in fact, sugar beet was almost the only crop from which the farmer obtained a higher cash return in 1920 than during the previous year.

While the growers of beetroot have had reason to consider 1920 a very successful year, the results from the viewpoint of the companies engaged in working the roots into sugar have been far less satisfactory. The reason is, of

course, that everything entering into the making of the crop, including roots, labour, bags, coal, oil, and all sorts of supplies commanded high prices, while the market quotations for sugar have been steadily and almost continuously declining from the time when the beet sugar output began to come upon the market. On the present wholesale price basis of 6.50 cents (31s. 4d.) the lb., only two or three of the largest manufacturing companies are able to find themselves whole, while the smaller companies are losing from \$1 to \$4 (4s. to 16s.) on every bag sold. Beet sugar, by the way, is marketed in bags holding 100 lbs. each.

The financial report of the American Beet Sugar Company for the year ending March 31st, 1921, has just been published. This company may be considered a fairly typical representative of the beet sugar manufacturers, and its statement shows net earnings of \$431,058 for the year. After deducting dividends paid on the preferred shares the company has a deficit of \$166,491, as compared with a surplus of \$925,810 at the close of the preceding year.

Not only are the manufacturers of beet sugar sustaining heavy losses on the operations of the past season but their crop is being marketed very slowly. Ordinarily the bulk of the crop, except that part which is retained for local consumption in the immediate vicinity of the factories, is sold before this date. This year, however, fully half the crop, roundly 10,000,000 bags, remains still in the hands of the producers.

As a result of these discouraging conditions and of the lower prices being offered for beetroot the acreage in sugar beets for the coming season will show a reduction of possibly 20 per cent. as compared with last year. The cost of production of the coming crop, however, will be materially less than was the case during the past season and with a continuation of current prices the sugar companies will be able to make a much better showing at the end of the year. Most of them have profited by the experiences of recent months to the extent that they have adopted a form of contract with the growers which provides that the price paid for beetroot shall be based upon the market price of sugar. A minimum price per ton is guaranteed the grower. In most instances this is six or seven dollars. An additional sum of a dollar per ton is to be paid for each cent. per lb. advance in the price of sugar. In many cases there is a double graduation, based not only on the market price of sugar but also upon the percentage of sugar in the roots delivered. This is an adaptation of the form of contract generally used in the cane sugar industry, and is recognized as a more equitable basis of payment than one in which the entire risk is assumed by the manufacturer!

New York, May 18th.

Measures are being taken by the Distillers Company, Ltd. to produce a motor fuel on a scale large enough probably to make it a serious rival to petrol. It consists of a mixture of 50 per cent. of alcohol, 25 of benzole, and 25 of paraffin. The new fuel, it is stated, can be produced in large quantities at 2s. 8d. a gallon, which is considerably cheaper than the present price of petrol. The mileage, however, is not quite so high. A slightly higher compression is required, but its use exercises no harmful effect upon the engine.

A liquid fire projector, of a similar type to that used in the Zeebrugge raid during the war, portable and simple in operation, has been placed on the market for use in agricultural purposes. It weighs 50-60 lbs., and may be carried over the shoulders like a golf bag. It is capable of projecting liquid fire 80-90 ft. for about half a minute, or it may be made to give intermittent shots. This apparatus is said to have been used successfully in tropical climates for combating locusts, for destroying flying foxes (in Queensland), and for burning down bush in the neighbourhood of sugar and other plantations.

Meditations on Trapology.

The Rôle of the Steam Trap in the Sugar Factory.

By J. O. FRAZIER.

Sugar Engineer, New Orleans.

II.

As is generally quite well known return steam traps are in rather less favour than the non-return ones. This in spite of their nominally duplex service, which consists not only of extraction of condensation drainage, but its delivery into the boilers as well. This can well be true because of the many more situations in which the non-return ones apply, therefore the very much wider use; also, in their lower first cost and that of installation, and a greater simplicity of installation and action, which, however, is more apparent than real.

In addition to greater first cost, for a given volume of water a considerably larger size is required with the return trap. This is based upon the following comparative facts: In the case of practically all non-return traps, in all situations, they discharge into the open, or at least into some enclosure of little or no pressure. Thus is brought about the maximum pressure difference between inlet and outlet, which is the primary capacity-determining factor in all steam trap installations. To this is added the non-return capacity advantage of receiving water all the time when

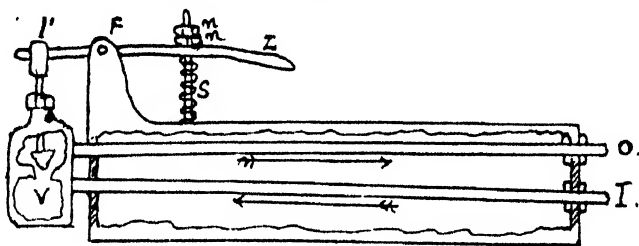


FIG. 2.

presented, even during periods of discharge, where regular discharge is periodical as in all intermittent traps, both return and non-return. Thus the non-return steam trap, even among those operating by accumulations has a continuous discharge. To appreciate the value of this fact may be cited observations on return traps whose filling period has been observed at 20 seconds, while the time of discharge into the boilers was from 45 seconds to 60.

All of the class of traps designated as "expansion" traps are of the non-return class. Valve movement in all this class is either brought about by expansions of metal tubes, differential expansions of the same, or, in some cases by the expansive action of fluids confined in a small chamber forming a part of the machine. Practically all of the expansion class are of very moderate valve movement. Linear expansions, although of very positive reliability, are of comparatively small extent, and are often multiplied in conveying movement to the valve.

In Fig. 2 is shown an example of a differential expansion non-return steam trap. This may be taken as illustrative of the ingenuity displayed in the application of differential expansion and its multiplication. In this Fig. 2 is shown a cast-iron housing shell, partly broken away and partly in section. At the right hand end of this shell, brass inlet tube *I* and iron outlet tube *O* are secured by lock nuts to the end of the casting shell as shown. These tubes swing freely

toward and from *F*, carrying the valve box *V*, with valve and seat shown. The valve lever *L* passes through a link *I'* and is fulcrumed at *F*. The spring *S*, shown on a stud has sufficient strength to resist the steam pressure and hold the valve closed against such pressure when conditions warrant. The position of lever *F* is fixed by the lock nuts shown on stud as *n,n*.

The outlet valve is shown in an arbitrary position and the method of valve adjustment is as follows: With steam available, the lever *L* is depressed against the spring, to the extent of wide-opening the valve, which moves freely within its casing. Steam will then blow through, when the maximum heat of the tubes has been reached; within a minute or so, the tubes will have reached their maximum length difference. The brass expanding the most, and being securely held at the inlet end, must move in some direction to accommodate the increased length. The result is that the valve box ends of the two tubes will have swung towards *F* to their furthest range, carrying the seat of the valve—which is the moving part—with them. If the lock nuts *n,n*, be then slackened the spring will force the valve to

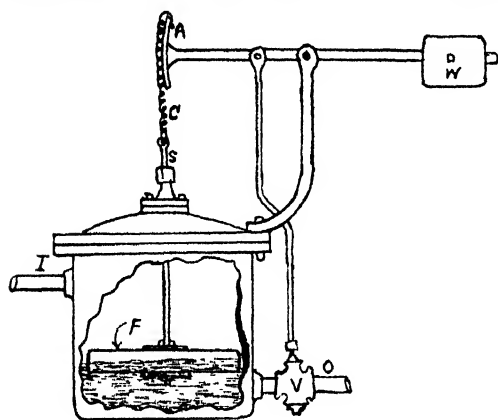


FIG. 3.

its seat—in the closed position. The nuts are then locked and the trap closed at its highest heat. Any contraction in the tubes from the inflowing water will carry the seat away from the valve in proportion to the degree of contraction, and, nominally, in proportion to the amount of water. The multiplication of movement is brought about by the long radius of tube length compared to the base distance between *I* and *O*. At any time during operation the lever *L* may be pressed down and allow

a blow through to clear away any accumulation of scale.

Among the oldest of non-return steam traps are those of the float type. Even at the present day they are the most numerous in use. Generally they take advantage of the buoyancy of a hollow metal float as a valve moving force; floats of copper or iron, mostly of the former, as probably safest against infiltration of water, although, as is shown further along, this is not a universal solution. This is truly a differential force, of which a more impressive example is shown in Fig. 3.

In this figure is shown a very ingenious application of the difference between a solid—heavier than water—float, with varying degrees of submergence of an ordinary grindstone, although a metallic solid would serve the same, except for the inconvenient weight for given displacement. This is more strictly differential than the hollow floats. This figure will be seen to consist of a chamber—partly broken away—in which the solid float is maintained at partial submersion by the weight *W*. The valve *V*, on the outlet *O*, is of the balanced type similar to those used on steam engine centrifugal governors. The result is a continuous flow through the trap, and a degree of submersion in the float *F*, in proportion to the inflow of water. It will be noted that the float spindle, *S*, is doubly assured of direct movement by the circular segment *A*, and the flexible chain connexion *C*.

This ingenious balancing of forces was the invention of one of Louisiana's pioneers and most accomplished sugar engineers, Mr. W. W. TAYLOR, of British

Meditations on Trapology.

birth and training. The American patent was of about 1880 date. The invention has been very widely used in our Louisiana sugar factories, and it continued to function with satisfaction long after its venerable inventor had passed to his reward. The basic idea of this invention was to avoid the difficulties of water-logged floats, which incident is by no means uncommon, as detailed below.

Among the writer's experiences is one in particular of a copper ball float. This float, although subjected to only 5 lbs. pressure and handling exhaust steam condensation, sank with tolerable regularity about once every fortnight. It had been repeatedly examined for flaws, or holes, and none found. Having been impressed with some of the many virtues of graphite, it was resolved to try this as a filler of pores too small to reach other than with paint. The float was removed during the "dead" season and several very thin coats of graphite and linseed oil were thoroughly rubbed on by hand. The result of this treatment was that, although it was under subsequent observation for a period approximating something like 20

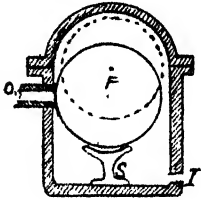


FIG. 4.

former sinking periods, it was never again known to sink. It is very probable that the same treatment would equally apply with an iron float, because the chance of rubbing into the pores, and the general adhesion, should be much improved with the rougher iron surface.

One of the newest of the American float traps—non-return—is shown in Fig. 4. This covers the very unusual if not only example of applying the float directly, without any intermediate gear, and in fact as the valve itself. In this case *F* is a copper ball float, *O* is the outlet, having an inwardly projecting nozzle with a ground valve seat where contact is made with the float. *S* is a support, which, when the trap is inactive, supports the float in close contact with its seat. *I* is the inlet, and the dotted circle shows the float in its extreme open position. Designers of steam traps usually seek to embody the feature of a wide open valve during periods of inaction, so that the first incoming water will find an immediate outlet. It will be noticed that in both Figs. 3 and 4 the float is at rest with the outlet valve closed, and some accumulation of water is necessary to open the latter.

It is very common, among American non-return steam traps, to find the real valve opening, which determines its capacity, as only a small fraction of that of the area of the pipe connexion and from which the size takes its name. These openings have been observed at not above one-sixteenth the area of the pipe connexion. Halves and quarter sizes are quite common. The difficulty usually is one of raising any considerable valve area against the pressure. The general run of expansion traps are the worst examples of this. The difficulty is sometimes overcome with a pair of valves, one opening with and one against the pressure, or some form of balanced valve, as shown in Fig. 3.

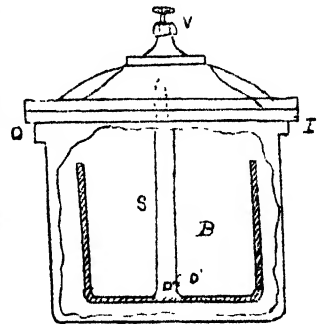


FIG. 5.

In contrast with Fig. 4, mentioned as one of our newest float traps, is shown Fig. 5, which is claimed, with no dissent heard, to be America's first successful effort at steam trapping. This is familiarly called a "bucket" trap. Of the usual so-called "pot" type, it is shown with a side wall removed to expose the

bucket float. The action is that accumulations of water around the bucket occur until the water runs over the sides into the bucket; this fills and sinks; on sinking it opens the outlet valve in the cover near the dotted line by means of a valve rod projecting upward through the pipe sleeve *S*. In this case the outlet is at *O* and the inlet at *I*. There is a by-pass at *V* in the top through a passage in the cover. Although valve details are not fully shown the action will be easily understood. In justice to this antique it is probably a correct estimate that there have been, and are still used, more of this particular type than of any other of American make: easily several times as many. It will be in order to note that the initial discharge is through the opening *O*¹ in the sleeve *S*. This type, as in most of our non-return traps, suffers from restriction of opening from that indicated by the pipe size. The practice of using by-passes, either as a part of the machine, or supplementary in the piping, is somewhat common, and, while it might indicate some lack of confidence, is defensible on several grounds, which will readily occur to the engineer.

With little if any further reference to the non-return class of steam traps, these articles will now concern themselves mostly with the return class of machines in succeeding issues. It is well to intimate that the problems of non-return trapping are practically all involved in operation of the return class; there are also very many engineering angles not common to the non-return and which must have attention for any considerable degree of success in operation.

(To be continued.)

Saving Money with Frozen Cane.

By ARTHUR H. ROSENFELD.

On 24th June, 1918—since which date the venerable John has not been the most popular in the calender of saints in northern Argentina—fell the most severe and most unexpected frost in the checkered history of Argentina's sugar industry. After a beginning of winter absolutely springlike in character—replete with balmy nights and crop-interrupting showers—with the cane continuing its growth far too exuberantly for the good of the purity coefficient in the sugar-house and, therefore, with the crop hardly more than commenced and the cane in the poorest possible condition for withstanding low temperatures, the mercury suddenly began to drop after a strong wind on the early morning of the 23rd, had reached the freezing point by five o'clock in the afternoon and in the morning hours of the 24th—which day is supposed to usher in what is popularly known as "St. John's little summer" in the sugar-producing provinces of the Argentine—a minimum of from 15° to 18° F. was reached all over the sugar district, the frost extending to the northernmost cane regions of the provinces of Salta and Jujuy, although being decidedly less pronounced in intensity and duration in these more tropical districts. At nine o'clock on the morning of the 24th the temperature was still below the freezing point.

Fortunately, cold weather continued through almost all of July, 22 successive frosts being recorded in the next 23 days, else the Argentine sugar crop would have been practically a total loss within the following 15 or 20 days. As it was, even though purities were distressingly low when the frost fell, prices were sufficiently good at that time—the last months of the Great War—to warrant continuance of crop for some six or seven weeks longer, or until decomposition had gone so far in the cane that no amount of topping would leave remnants of cane from

Saving Money with Frozen Cane.

which enough sugar could be extracted to pay for the cost of manufacture. The cost of harvesting the cane was not included in the estimated manufacturing cost, as the cane had to be harvested and removed at all events before cultivation of the stubble could be initiated.

When, with the advent of warm weather in August, the rapid fermentation of the cane made further grinding totally impracticable, the cane-growers found themselves with from 50 per cent. to 75 per cent. of their cane standing useless in their fields and confronted with the enormous expense of cutting and removing this huge crop—had it not been for this unparalleled frost the crop of 1918 would have broken all records—before they could start their ordinary operations of cultivation. Haste, too, was imperative, lest the decomposition destroy the germinating potentiality of the stubble.

All over the district planters began to burn the cane in the fields, cut it as if for crop and haul it to alternate headlands or waste places to be later reburnt upon more complete drying out by the sun and wind. When it is taken into consideration that the Argentine crop of 1918 would have averaged around 20 tons per acre, the author's estimated cost for these preliminary operations of £2 10s. per acre will seem very conservative indeed.

At "Santa Ana," the largest of the Argentine plantations, of which the writer was then in charge, about 11,000 out of our 15,000 acres of splendid cane was still standing when the mills ceased turning, some 7500 acres of this being plant.

As soon as the approximate extent of the disaster was seen after the first frost, the writer determined to try out on a large and absolutely conclusive scale the use of this frozen cane as a mulch, following the principle of the use of the trash in the Cuban cane fields for this purpose and the excellent results obtained by ECKART in the Hawaiian Islands with his tarred paper mulch. The Cuban method of mulching each alternate row with the preceding year's trash and cultivating these rows the following year had clearly demonstrated that weed growth can be practically controlled by such artificial mulching, while Eckart's tarred paper mulches at Olaa and other Hawaiian plantations had proved that the principal rôle of cultivation between cane rows—at least in plant and first-year stubble—is the suppression of weeds and maintenance of a mulch for the breaking of the capillary tubes of the soil and the consequent reduction in the loss of the soil's humidity through uninterrupted evaporation. Why, then, could not this frozen cane be used just as the trash in Cuba or the tarred paper in Hawaii?

The idea was new, however, for South America and met with extreme opposition among the colonists and even among the higher officials. Nevertheless strict orders were issued to the colonists and employees not to burn off the abandoned fields and by the time that crop was drawing to an end plans had been perfected for the carrying out of the mulching process on both commercial and experimental lines.

Most of the cane mulched in this manner was that year's plant—the first-year stubble of the 1919 crop—for the reason that all stubble had been rather irregularly cut over on account of higher maturity and also because for the plant cane the soil had been thoroughly prepared only about a year previous and the rows had been kept cultivated up to a late date, the cultivation of the plant cane having been finished only in March. The middles of the plant cane, hence, were in a fairly good state of tilth when the artificial mulching was undertaken.

The plant cane was practically untouched by the *machete* and vast areas were ready for the trial. Most of our sections were laid off in fields of about 25 acres each, with a 17 or 18 ft. headland between them. In order to get accurate data on

results for fields under varying conditions it was resolved to mulch as far as possible alternate rows in alternate fields, i.e., to leave every other field as a check on the fields having each alternate middle mulched, the unmulched fields and the unmulched alternate middles in the mulched fields being cultivated in the ordinary manner. Hence it would be necessary in the crop of 1919 only to secure trustworthy data on the yields and analyses from the alternate fields, which, correlated with the saving on the removal of the frozen cane from the fields and the difference in cost of cultivation in the two classes of fields, would give us the actual financial loss or gain on the results.

The fields, therefore, were laid out where possible more or less as shown in the accompanying diagram.

1	2	3	4	5	6	7	8	9	10	11	12
Mulch	Check	Mulch	Check	Mulch	Check	Mulch	Check	Mulch	Check	Mulch	Check
25 Acres					25 Acres					25 Acres	

Some 5000 acres were included in the tests, which covered our holdings all over the province of Tucuman, just about half of this acreage being actually mulched, the other half serving as check fields, as shown in the diagram. In general the frozen cane from two rows of the mulched fields was carefully piled in the one middle, leaving the alternate middle for cultivation, sufficient space being left close to the rows for the weeding of these with spades or hoes. In some cases, where the cane had been accidentally or intentionally burnt, the burnt cane was piled in every third, fourth or fifth middle, but the results from the fields in which the mulch was piled in every alternate middle make it unnecessary to take into consideration those from the more sparsely mulched fields, the same principle being involved and the economy of the system being in direct proportion to the number of middles mulched.

From the start there was certainly no inferiority in the appearance of the mulched fields. In many cases, in fact, in the unirrigable portions, the mulched

Saving Money with Frozen Cane.

fields showed a richer colour during the dry early spring, due to the better conservation of the humidity of the soil of the mulched middles, which, naturally, affected all of the rows of the mulched fields. A few opponents of the system claimed that flies bred in the mulch and were in greater abundance than usual in the summer of 1918-19, but the author could not notice any material increase in the overwhelming swarms of these insects so characteristic of Northern Argentina.

In 1919 there was practically no frost and for the first time in his long experience at "Santa Ana" the writer was able to obtain complete data from his large-scale experiments. With the system of returns installed it was easy to secure accurate data on the yield in field and factory from each section, together with notes on the time of harvesting in each field and section. These data have now been compiled and elaborated, but are so overwhelmingly favourable to the mulching system and so large in number that it seems unwise to further prolong this article by publishing them in detail. They may be succinctly summarized by stating that in practically every case the mulched fields produced just as much cane per acre, with just as good purity of juice, as did the unmulched fields, while in many cases, in the unirrigated sections, the mulched fields produced slightly better average yields than did the regularly cultivated ones—and this with just half the per-acre cultivation cost of the unmulched fields, an important factor in a year following several disastrous crops, when money is costly and difficult to obtain. No appreciable or regular effect upon the chemical analyses of the cane and juices could be noted, although hundreds of these were tabulated and studied.

Let us conclude, therefore, with an estimate of the financial advantage of this system over that generally employed all over the Argentine sugar district of burning and carrying off these tens of thousands of tons of frozen cane, without taking into consideration the inconvenience of cultural operations with the headlands filled with this refuse, and taking the average yields from the two series of fields as being identical.

The cost of cutting the cane and piling it in the middles averaged just about £1 per acre—with the higher wage scale now prevailing this figure would be higher, but that for burning and hauling off the cane would be higher also in proportion, so the comparison stands; hence we have an initial saving of £1 10s. per acre. Now the cost of cultivation in 1918-19 at "Santa Ana" was just about £4 per acre. By the mulching of half of the rows we saved just half of this expense, as only every other row was cultivated, which £2 added to the initial saving of £1 10s. gives us a total per-acre saving of £3 10s. On the twenty-five hundred acres mulched on the "Santa Ana" properties, this represented an actual economy in cultivation operations of £6250.

Would it not pay planters in subtropical cane regions to give this system a trial in years of heavy early frosts?

C. THOMÆ¹ recently pointed out that dry sugar (sucrose) when mixed with tobacco ash is very readily ignited by a lighted match. L. BRANDT,² however, describes experiments showing that the ferric oxide present in such ash cannot be the active agent. Some 10 or 15 years ago it was mentioned that if a piece of sugar be moistened with a drop of blood it will burn on ignition with a lighted match in the energetic manner described by THOMÆ. A number of other substances have been found to have this effect of increasing the inflammability or rate of combustion of sugar, apparently acting as catalysts, for instance, sodium silicate, and the oxides of copper, chromium, manganese, zinc, lead, and also many salts in the dry state and in solution, e.g., ammonium chloride, calcium chloride, cobalt nitrate, lead nitrate, copper sulphate, concentrated sulphuric acid.

¹ *I.S.J.*, 1920, 703.

² *Chem. Zeit.*, 1920, 44, No. 142, 881.

Preliminary Studies on some Fungi and Bacteria responsible for the Deterioration of South African Sugars.¹

By PAUL A. VAN DER BIJL, M.A., D.Sc., F.L.S.,
Botanist and Mycologist, Natal Herbarium, Durban.

As stated in the title, the study herein recorded is only of a preliminary nature. The whole question of sugar deterioration and "sweating" in storage is one which embraces several phases, and until all the avenues of research bearing on the subject have been thoroughly investigated, it will of necessity not be possible to generalize to any extent.

In this paper we deal with four fungi and three bacteria, all isolated from samples of so-called "sweating" sugar.

PART I.—FUNGI OR MOULDS.

An opportunity of studying fully the morphology of the fungi has not yet offered itself, and it is considered advisable to deal with this aspect in a separate paper after more of them have been isolated and studied. For this reason brief notes only are given on the fungi.

Aspergillus sp.—This same fungus was obtained from sugar at different times, and two isolations of it were utilized in almost all of the experiments. The fungus is illustrated in Fig. 1. The conidial herbage is greenish, and at (A)

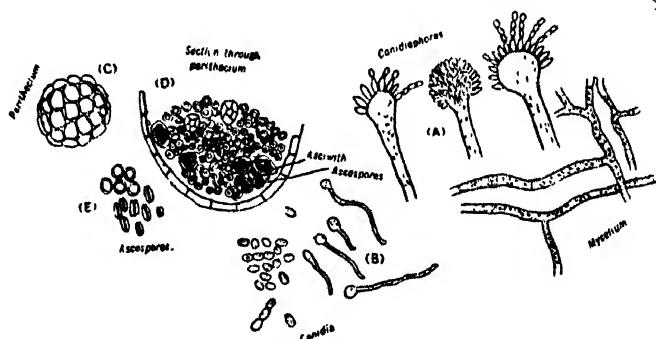


FIG. 1.—*Aspergillus* fungus.

are shown the swollen conidiophores which bear the finger-like processes from which the conidia are abstracted. At (B) are shown some conidia germinating. The conidia are globular to more or less elongated, with smooth or minutely punctuated walls, and measure 2.4×4.8 or $2.4-3.6 \mu$. This fungus very readily develops another fruiting body, which takes the form of a yellowish case, illustrated at (C), and in which on cutting it across we notice a number of sack-like structures (asci), each of which contains a number of spores (ascospores). Such a section is shown at (D), and at (E) are shown some of the ascospores. The ascospores are ellipsoidal, exhibit a longitudinal furrow, and measure $3.6-4.8 \times 2.4-3 \mu$.

Stemphylium.—This fungus offered considerable difficulty in placing it, and until such time as it has been further studied it is provisionally placed in the

¹ Editorial summary of Science Bulletin No. 12, published by the Department of Agriculture, Pretoria, Union of South Africa, price 1d.

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genus *Stemphylium*. The spores are brown in colour, large, and divided by transverse walls into many cells. Some of these cells are again divided by a longitudinal septum. This fungus is illustrated in Fig. 2.

Sterigmatocystis.—This genus is not sharply defined from the genus *Aspergillus* mentioned above. In *Aspergillus* the finger-like process arising from the swollen head bear the conidia directly, whereas in *Sterigmatocystis* they bear secondary finger-like processes, and these bear the conidia. The fact that simple and branched finger-like processes may occur in the same fungus is, however, unfavourable to such a distinction being made, and *Sterigmatocystis* is now usually merged in *Aspergillus*. I use the name *Sterigmatocystis* merely to distinguish this

fungus from the previously mentioned *Aspergillus*. This fungus is illustrated in Fig. 3, which shows that the conidia of this fungus are round, and that their outer walls are rough with minute projections. They are $2.4-3\ \mu$ diameter. The conidial herbage is dark greyish green. To date this fungus has produced only conidial fructifications.

These few remarks on the nature of the fungi are at present sufficient for our purpose. They were tested to see whether they contained the enzyme invertase,

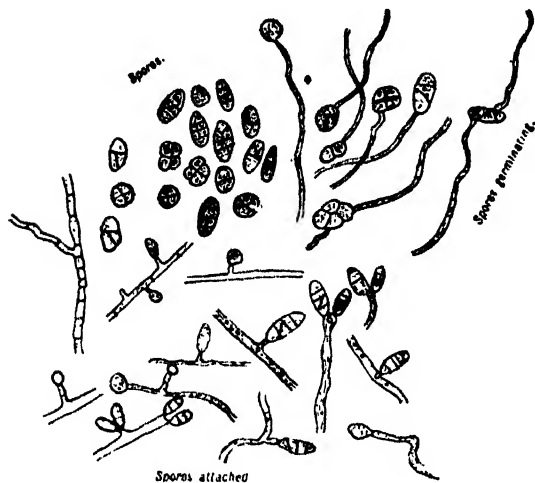


FIG. 2.—*Stemphylium* fungus.

which inverts cane sugar. Dox solution¹ and 100 mill sugar solution (20° Brix), clarified with alumina, were therefore inoculated and examined after four days. Both reducing sugars and acids had been formed, two *Aspergilli* fungi giving the highest results.

In addition to the results thus obtained, it seemed desirable to infect some solid sugar as well. For this purpose, 20 grms. of refined sugar were sterilized in sterilized flasks, inoculated with the fungi, and as nearly as possible the same amount of sterilized water sprayed into each flask. An analysis was made 22 days after inoculating at 27° C., the following being the figures obtained:—

Fungi.	Moisture. Per cent.	Invert Sugar. Per cent.
<i>Aspergillus</i>	2.10	1.3
<i>Stemphylium</i>	2	1.2
<i>Sterigmatocystis</i>	1.8	1.03
<i>Aspergillus</i> (a)	2.3	2
Control	1.7	0.49

The above left no doubt that the fungi had inverted the sucrose. To obtain conditions more in accordance with what would take place in storage, 10 grms. of sugar were weighed out in previously sterilized flasks, and infected with the fungi. Instead of directly adding water to the sugars, they were placed, together with a

¹ Sodium nitrate, 1; potassium nitrate, 1; potassium phosphate, 0.5; magnesium sulphate, 0.01; potassium chloride, 0.01; ferrous sulphate, 0.01; sugar, 30; and water, 1000.

small beaker containing a saturated solution of sugar, under a bell-jar, being thus able to absorb moisture from their surroundings. After inoculation at 27°C., results were again obtained indicating that the fungi had inverted the sucrose. It was also seen that the infected sugars had taken up more moisture from their surroundings than the control sample, due presumably to the greater hygroscopicity of invert sugar, which fact appears to have some bearing on the process popularly known as "sweating." However, it may be mentioned that "sweating" may result in the absence of micro-organisms, owing, it is held, to the adhering film of molasses under improper conditions of storage.

Other experiments which were carried out showed: (1) That with the exception of *Stemphylium* all the fungi grew in solutions of 63° Brix, the highest concentration tested. *Stemphylium* developed in solutions of 58·7° Brix, but not in those of 63° Brix.

(2) That the fungi do not withstand the temperatures met with in sugar factories, the immersion in boiling water for 15 min. of tubes containing solutions inoculated with them being sufficient to kill them all.

(3) That the addition to 50 c.c. of mill juice of 0·27 grm. of sodium fluoride; or 0·5 grm. of ammonium fluoride; or 4 c.c. of 5 per cent. sodium bisulphite solution; or 12 c.c. of 0·5 per cent. commercial formalin; or 6 c.c. of 2 per cent. chloride of lime solution (16 per cent. available chloride); or milk-of-lime containing 5 per cent. of CaO, sufficed to inhibit the growth of all four organisms.

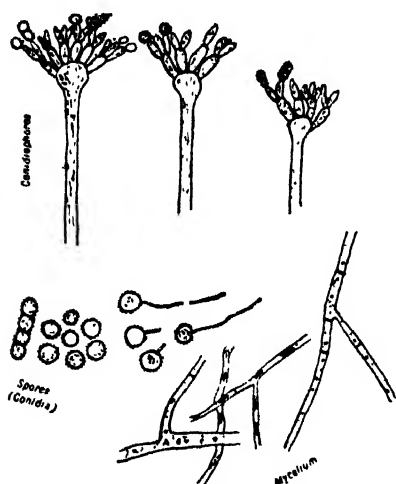


FIG. 3.—*Sterigmatocystis* fungus.

An additional fungus was obtained when the work on the other four was nearly completed, and it was thought desirable to embody the few results about it in this paper. This fungus is *Hormodendron cladosporioides*. Its spores are coloured, and their method of formation is illustrated in Fig. 4. It was found to invert and acidify Dox solution.

PART II.—BACTERIA.

The three bacterial organisms from sugar which we have thus far worked on belong to the potato group of bacilli. That they are all closely related is shown by their cultural, morphological, and physiological characters, the organisms designated as Bacillus I and Bacillus II being nearest to *Bacillus vulgaris* and Bacillus III to *B. ginsengensis*. We have not thus far made any systematic survey of the micro-organisms occurring in mills, but have incidentally obtained one belonging to the same group of bacteria from juice at the first roller.

Experiments showed the three bacteria to be capable of inverting sucrose and forming gum; and a study was made of the growth characters of the three on beefbroth gelatin stab, potato, beefbroth agar, and on sugar agar. It was also found that the spores of the bacteria was highly resistant, surviving 100° C. in cases even as long as two hours. Neither 1:50 formalin, nor 1 per cent. sodium fluoride, proved germicidal after 30 minutes' exposure.

Preliminary Studies on some Fungi and Bacteria.

PART III.—GENERAL CONCLUSIONS.

On studying a chart of the relative humidity and temperature at Durban during the year, it would be at once perceived that the periods during which most trouble is experienced by "sweating" and deterioration were those when the relative humidity and temperature are highest.

Regarding "safety," we have thus far not looked into the different factors inherent in South African sugars which would influence the absorption of moisture, though it is a matter we hope to go into yet. The size of the crystals would probably be one which suggests itself, since smaller crystals would offer more surface to moisture absorption. Other factors may be found in the physical and chemical composition of the sugars, but they remain to be investigated. The remaining factor in the absorption of moisture has to do with the construction of the storehouses themselves. In many instances, what probably takes place is that with a fall in temperature moisture gets deposited on the sugar.

It has been suggested that the storehouses should be constructed with double walls so as to allow a circulation of a current of air between the walls, and at the

same time prevent the admittance of moist air during unfavourable weather conditions. It would also appear that some provision should perhaps be made whereby the storehouses could be kept dry during the months of high humidity.

Next to moisture, the most important factor in sugar deterioration is probably the temperature.

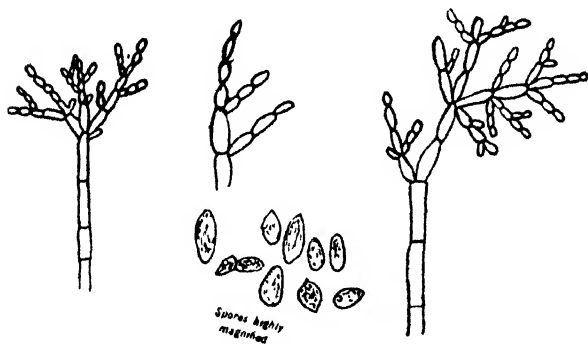


FIG. 4.—*Hormodendron* fungus.

It has been suggested that cold storage should be combined with dry storage.¹

Earlier in this paper we have noted the resistance to heat which the different organisms show. We have seen fungi are readily killed by the temperature of boiling water, whereas bacteria are very resistant. Fortunately we now know that bacteria are not the main causes in sugar deterioration. They appear to exert an action on the crystal sugar only when the moisture content is abnormally high, and further they cannot thrive in such high densities as the fungi. That the main agents in sugar deterioration—the fungi—readily succumb to heat may suggest the sterilization of sugars, but even when sterilized subsequent infection would still have to be guarded against.

In Louisiana at present studies are being made on the possibility of actually sterilizing the sugar and washings in the centrifugals by means of super-heated steam.² It is also primarily from this viewpoint that previous workers have suggested the substitution of water by steam at the centrifugals.

It is the general opinion that in mills the infection takes place chiefly at the centrifugals, and this may in some measure be due to the air sucked through with the rapid revolving of this machine, as has been suggested. Probably covering the sugar conveyances to the centrifugals, and also from the centrifugals, would further remove some sources of infection.

¹ See *I.S.J.*, 1919, 238.

² *I.S.J.*, 1920, 591.

Generally speaking, more and more stress is being laid upon the importance of cleanliness in the factory as a preventive in the deterioration of mill sugar. It is thought that the experiments with the antiseptics mentioned in this paper may be of some value in this connexion.

In our experiments with these various disinfectants we do not necessarily mean to suggest that they are all equally suitable for use in factories, etc. Among the main considerations should be their cheapness and whether they are easily procurable. Formalin, chloride of lime, and milk-of-lime appear to be the three most suitable. Milk-of-lime should be useful for disinfecting the walls and ceilings of storehouses, etc., and cleaning the tanks. Chloride of lime has a high germicidal power, and should be specially useful for disinfecting filter bags and tanks containing fermented juices. It remains only to mention that these disinfectants are more efficient at higher temperatures, and in the disinfection of sugar factories are preferably used hot.

With these remarks we close this preliminary investigation, and while realizing that much still remains to be done, trust that the data herein recorded will in the meantime prove of some little value to the sugar industry.

A Continuous Centrifugal Machine.

By JOSEPH AVRUTIK.

The patent just issued to me,¹ represents the original design but in incomplete form. Since the time of filing, modifications in general design have been made and the working parts co-ordinated. Applications for these improvements have been filed in the United States, in European and in South American countries.

A complete sketch showing all parts, and in outline similar to the trial machine now being built at the Ingenio Rio-Cauto of the Cuban-Canadian Sugar Company, Oriente, Cuba, is here reproduced, and an explanation of the working of the various parts now follows:

1. *The Coil System and its Functions.*

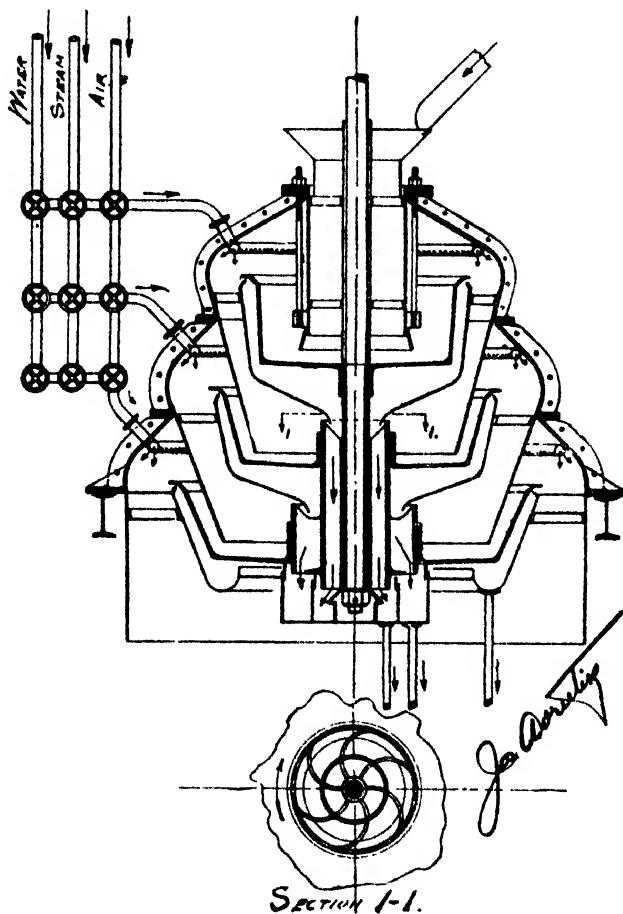
It differs from the original design largely in that a system of coils supplying compressed air, steam, or water is added. This coil system co-ordinates the feeding speed from one stage to the next, so as to deflect the substance downward from its course and to keep the deflecting circular partitions free from any sticking particles. It is obvious that the discharge from the basket, being actuated by centrifugal force, will be rapid, whereas the delivery into the next stage by the deflecting circular partitions, caused by gravity alone, will be slow. Compressed air is the medium used to make the stream of substance continuous and uniform in speed at each stage. The next function of the coil system is to deflect and direct the outflowing substance downward into the next stage of operation. The forces of compressed air are so arranged and directed, that one part forms an air cushion between partition and substance, so breaking the force of impact; whereas the other part of the force forms a solid curtain all around the basket acting upon the outflowing substance and directing it downward into the lower stage. Finally the air force will sweep the deflecting partitions, keeping them clean from any sticking particles.

¹ U.S. Patent, 1,360,708; *I.S.J.*, 1921, 300.

A Continuous Centrifugal Machine.

2. *Separate Liquid Outlets from each Pan.*

An arrangement of small perforated piping is adjusted within the baskets and may be used as a water or steam spray for washing purposes. When using a four-stage separator, air can be applied in two stages, water or steam in the third, and air in the last again. This compound operation naturally produces liquids of varying density and purity; and in order to separate them and conduct them into different receptacles, each molasses pan is provided with a separate outlet. One form is shown in accompanying sketch. A series of hollow cylinders are connected by ribs to the hub. Each pan discharges its liquid into one of these cylinders through which it flows down into a compartment tank. A pipe leading from each compartment conveys the liquid to its destination. The ribs connecting



the different cylinders to the hub are so constructed, that air will be drawn through the passes and so facilitate the flow of the liquid and overcome the slight centrifugal force acting upon it. Other arrangements have been designed for the same purpose, but because of lack of space cannot be mentioned here.

3. *Control of Quantity to be admitted for Treatment.*

In order to make the separation complete and uniform for various substances having a different degree of concentration and viscosity, the quantity of substance

admitted into the first stage must be controlled and regulated. In the original design, the aperture between the bottom of the first drum and the deflected outside casing was of a permanent nature. The amount of material could only be regulated at the gate near the source of supply. This involved certain disadvantages. Improved details, as shown in accompanying sketch, allow the control and regulation of quantity through the same aperture at any time during the operation, and independent of the source of supply. The top section of the outside casing forms an opening, into which a circular pipe is suspended, the flanges of both being bolted together. On the lower part of the pipe is adjusted by several suspension bolts an easy sliding sleeve, which is first placed at a certain height from the bottom of the drum and securely held by nuts. The projection of the bolts above the nuts is equal to the height of the aperture through which the substance is passing. Now when the aperture is to be changed, all that is necessary is to turn the nuts one way or the other. The sliding piece will change its position as desired and increase or decrease the aperture. By measuring the projection above the nuts, the height of the passage can be determined. The projection thus acts as an indicator.

It is a matter of common knowledge, that when drying low grade sugars in ordinary centrifugals, quite often the machine is stopped with the intention of allowing the moist inner layers of substance to fall to the bottom. The machine is then started again to force this part to spread upon the blanket of substance still clinging to the walls and so divest itself of the liquid. This partial shifting of a part of the whole contents, and partial re-arrangement of particles, materially improve the quality of the final product. It logically follows that if the practice of partial shifting and partial re-arrangement is thought helpful, the method of constant shifting, and thorough and complete re-arrangement of the whole quantity, combined with the increasing force in each successive stage, must produce a uniformly dry product irrespective of the degree of viscosity. The same consideration should be true in regard to the treatment of a strike containing an undue amount of false grain. From a mechanical point of view, in the design of the separator due consideration has been given to the type of labour usually employed in a sugar mill, the means on hand in regard to repairs, attendance, maintenance, etc. The very fact that a machine is being built in the shops of a sugar mill is sufficient proof of its simplicity.

At the annual meeting of the Natal Cane By-Products, Ltd., it was stated that the SIMONSEN denaturant had entirely fulfilled expectations, and "Natilite" had been considerably cheapened by its introduction. The demand for "Natilite" had for the past five months been far ahead of available supplies. It is mentioned that the Mahna, an Indian tree, may be exploited in the near future for the production of the alcohol for this motor fuel.

Prof. ALEX. FINDLAY and Mr. V. HARCOURT WILLIAMS¹ have examined the products resulting on the electrolytic reduction of glucose. O'BRIEN GUNN had claimed² that a hexahydric alcohol is produced. This could not be confirmed, nor could mannitol or sorbitol be detected in the film collecting on the cathode. Examination showed lead formate to be present in the film, and formic acid was also found in the cathode solution after electrolysis. An analysis of the gas formed at the cathode proved that it did not consist of pure hydrogen, but of a mixture of this gas with about 4 per cent. of carbon monoxide, presumably resulting from the decomposition of formic acid. Further, the presence of a pentose in the solution was demonstrated by the furfuraldehyde test. These results are in harmony with those obtained by LÖB³ on the electrolytic reduction of this sugar.

¹ Paper read before the Faraday Society, see *Chemical News*, 1921, 122, No. 3181, 145-147

² German Patent, 140,318, in which the inventor had stated that a yield of mannitol equal to 98 per cent. of the theoretical was obtained.

³ *Biochem. Zeitsch.*, 1909, 17, 132; *Zeitsch. Elektrochem.*, 1910, 16, 1.

The Question of the Loss of Sugar through the Presence of Fine Grain in the Final Molasses.¹

By Dr. JAR DĚDEK.

Chemist, Sugar Experiment Station, Prague, Czecho-Slovakia.

H. KALSHOVEN,² chemist at the Experiment Station, Soerabaja, Java, was the first to draw attention to the high content of microscopic grain present in molasses, which he succeeded in detecting and quantitatively determining by indirect optical analysis. By means of numerous figures, he showed the amount to be astonishingly high (up to 18 per cent.), and he demonstrated that it played an important rôle in the determination of the quotient of purity of the molasses by increasing the apparent value very considerably.

These analyses concerned colonial molasses only; so Professor E. O. VON LIPP MANN³ examined a number of run-offs from raw beet sugar manufacture according to the new method, and concluded that of 15 samples 1 contained 5 per cent.; 7, 5-10; and 3, 10-13 per cent. W. H. TH. HARLOFF⁴ drew attention to the great commercial significance of this loss of sugar, calculating that with an average content of 8 per cent. this meant 35,000 tons for the whole of Java, the value at that time being £1,500,000, or about £8000 for each of the 186 factories for the season.

At our experiment station (by which great attention has always been devoted to the refractometric method) Kalshoven's work aroused particular interest. STANEK and SKOLA⁵ had already used this method for the determination of the quotient of the syrups adhering to grain, and had arrived at a similar formula to that of KALSHOVEN, but so great were the sources of error that they were compelled to abandon it. The high quotients of the molasses of the present campaign having aroused the suspicion that they might be traced (at least in part) to the presence of fine grain, Mr. STANEK requested me to apply Kalshoven's method to our molasses. It was then soon seen that it required a thorough modification.

Not long after becoming acquainted with the matter, it was noticed that opinions both sceptical and directly adverse were not wanting. Thus, E. O. VON LIPP MANN⁶ published an article in which he communicated objections to the Kalshoven method "from a highly esteemed source," partly identifying himself with these objections. They concerned on the one hand the possible accuracy, and on the other the principal error, namely that due to the contraction occurring on the dilution of the molasses with water.

Recently, A. SCHWEIZER⁷ from the standpoint of the practician contested the possibility of such enormous quantities of grain in the molasses. Kalshoven's work had caused such surprise in Java that immediately control experiments were commenced. It was shown, for example, that perfectly clear molasses, filtered through thick cloth, when mixed with 3-5 per cent. of finest sugar dust gave an opaque massequite-like mass, and even 2 per cent. could with certainty be detected on spreading the mixture over a glass plate. A second reason against the presence of such great amounts of grain in molasses was found in the analysis of the molasses from the large tanks of many of the sugar factories in Java. Even after the long standing of the molasses in the tanks, the figures obtained for the lower layers did not differ essentially from those of the upper ones. Therefore SCHWEIZER

¹ Abridged translation from the *Listy cukrovarnické*.

² *I.S.J.*, 1920, 38-39.

³ *D. Z. I.*, 1919, 44, 527.

⁴ *I.S.J.*, 1919, 608.

⁵ Private communication.

⁶ *D. Z. I.*, 1919, 44, 598.

⁷ *De Suikerindustrie*, 1920, 20, 1.

concluded that Kalshoven's method involved unknown errors, which gave illusive results regarding the presence of grain.

Our present research deals with a modification of the Kalshoven process, making it possible to obtain reliable and readily reproducible results while working conveniently and rapidly. As has already been mentioned, Kalshoven's method is an indirect refractometric process depending upon the known phenomenon that scattered undissolved substances exert no influence upon the refraction of the solution.¹ If one determines the refraction of a molasses containing grain, only the refraction (that is, the degree Brix) of the grain-free molasses is found; while if this grain be brought into solution in any way or other, the refraction of the original molasses plus the grain is obtained, from which two measurements the grain content may be calculated. Thus, if the refraction of the original molasses is R_1 , and that of the molasses plus the grain is R_2 , then $R_1 = R_2$ if it contains no grain, and $R_1 < R_2$ when grain is present. Calling the per cent. of grain x , if the active substance be increased, R_1 falls percentually to

$$\frac{100-x}{100} R_1, \text{ so that } R_2 = \frac{100-x}{100} R_1 + x;$$

$$\text{or } x = \frac{100(R_2 - R_1)}{100 - R_1} \dots \dots \dots \text{Formula (1)}$$

The polarization of the molasses S is the actual polarization of the molasses plus the grain, it being determined after dilution. If one considers that $100 - x$ of a grain-free molasses contains $S - x$ of sugar, then the amount of sugar y in 100 parts of the molasses (that is, the polarization) is $\frac{100}{100-x} (S - x)$, and substituting x from formula (1) we have

$$y = \frac{S(100 - R_1) - 100(R_2 - R_1)}{100 - R_2} \dots \dots \dots \text{Formula (2)}$$

In order to determine the second refractometric reading R_2 , KALSHOVEN recommended dissolving the grain by diluting the molasses, it being said to be immaterial whether 10, 20, or 30 per cent. of water were added. However, one could also dissolve the grain by heating the molasses, though KALSHOVEN gave the dilution method the preference "on practical grounds." He had tested it by adding weighed amounts of sugar to molasses of known grain content, finding (he said) the figures to agree excellently.

Anyway, Kalshoven's method as now arranged is quite involved. It requires duplicate weighing, heating, and cooling, besides a lengthy calculation. TISCHTSCHENKO² sought to eliminate the error caused by dilution instead with a strongly concentrated solution of sugar. The difference indicated by him between these refractions and those obtained in our case with molasses diluted with water is approximately identical, and is capable of misrepresenting the amount of grain, as may be seen from the following table:—

REFRACTOMETRIC DRY SUBSTANCE.

TRUE DRY SUBSTANCE.		WATER DILUTION.		SUGAR LIQUOR DILUTION.		DIFFERENCE, 2-3.		APPARENT FINE GRAIN.
1.		2.		3.		4.		5.
77.51	..	78.22	..	78.04	..	0.18	..	0.82
76.00	..	77.20	..	76.20	..	1.00	..	4.20
74.66	..	75.80	..	74.70	..	1.10	..	4.34
79.33	..	81.30	..	79.38	..	0.92	..	4.46
77.80	..	79.11	..	78.10	..	1.01	..	4.61
83.51	..	84.82	..	83.54	..	1.28	..	7.77

¹ I.S.J., 1921, 169.² I.S.J., 1909, 195.

Loss of Sugar through the Presence of Fine Grain in Final Molasses.

I have also shown the influence of contraction by a direct experiment, in which a molasses showing no grain under the microscope was analysed for grain according to Kulshoven's method. When diluting with 21.4 per cent. of water, it indicated 1.18 per cent. of grain; and when diluting with 97.3 per cent. of water, as much as 4.89 per cent. of grain.

It is therefore clear that the dilution method gives a wrong impression regarding the presence of grain, and is not suited to beet molasses. Dilution

with a sugar solution according to Tschitschenko's process appears to us to be too tedious. We decided therefore on the heating procedure, as carried out in a closed "autoclave" (Fig. 1). This is a piece of copper or brass tube *a* about 1.5 cm. ($\frac{3}{8}$ in.) diam., 1 mm. ($\frac{1}{16}$ in.) thick, and 10 cm. (4 in.) long. It is tinned inside, and is provided at its lower end with an autogenously welded bottom, and on top with a turned-down fluted edge,

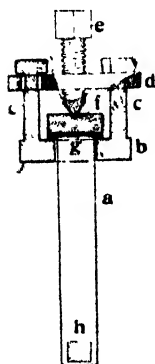


FIG. 1

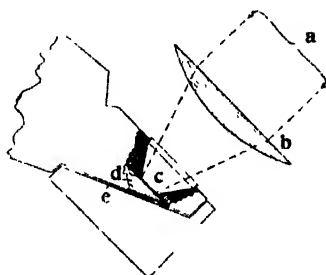


FIG. 2.

secured in an iron collar *b* having two bars, *c* and *c*, which latter carry a removable transverse piece *d* with a strong locking screw *e*. By means of this screw, a steel cover *f*, beneath which is a piece of lead sheet, is pressed against the opening of the tube. Inside the tube is a short brass cylinder *h*, having a slightly smaller diameter than the tube. It serves as an agitator.

The autoclave is almost entirely filled with the molasses to be examined (which must be stirred with extreme care); and the refraction R_1 , determined with a few drops, certain precautions (see later) being observed. The carefully closed autoclave is immersed up to the collar in a glycerin-bath at 110°C. (or better in a pot containing aqueous glycerin boiling at 100°C.),¹ and provided with a lid through which a thermometer passes. It is heated for $\frac{1}{4}$ hour, during which period it is removed two or three times with a pair of tongs and shaken, the brass cylinder *h* well mixing the whole contents of the tube. At the end of the 15 mins., the autoclave is cooled under the water tap, and then shaken until the mixing device no longer moves in the thickened molasses. Cooling lasts 2-3 mins., after which the autoclave is opened, a sample removed with a thin glass rod from the depth of the tube, and this placed upon the prisms of the refractometer, giving the refraction R_2 . From these two values, corrected to the same temperature, viz., 20°C., the percentage amount of grain is calculated with the help of formula (1). Neither weighing nor supervision is required with this method, and the glycerin-bath holds the temperature at 110-112°C. very constantly.

Regarding the possible accuracy, this depends (apart from a certain amount of manual skill) on the precision of the reading with the refractometer, and also on the relationship between R_1 and R_2 . It is clear that in a difference method (as this one is) the error of observation is the greater the smaller the difference between R_1 and R_2 , and the greater the value of R_1 ; in other words, the higher

¹ This temperature is the lowest which can be used for the certain solution of a large amount of grain when heat is applied for $\frac{1}{4}$ hour, that is, to reach the maximum refraction.

the dry substance of the mixture examined. In the neighbourhood of 70-80° Brix, the accuracy of the method falls to $\frac{1}{2}$; of 90° to $\frac{1}{3}$; and of 95° to only $\frac{1}{4}$.

Concerning the accuracy of the reading of the refractometer, O. SCHÖNROCK¹ estimates it at 0.1 per cent. of dry substance, and so the limit of error with this method is 0.33 per cent. of grain at 70° Brix, 0.5 at 80°, 0.67 at 85°, 1.0 at 90°, and 2.0 at 95°. This precision of reading, however, is occasionally very difficult to reach, especially in molasses rich in grain when observed by reflected light, often a very indistinct even hazy line being seen, incapable of being read within 0.5 per cent. Many molasses after being heated also behave similarly. After long experimenting, we have succeeded in greatly increasing the precision of reading with all molasses by means of a simple lighting arrangement (Fig. 2). The light *a* coming from a circular hole cut in a paste-board box surrounding a $\frac{1}{2}$ -watt lamp is thrown by means of a simple plano-convex lens *b* (from an old polarimeter oil lamp) directly on the plate *c* of the upper prism *d* of the Schönrock refractometer for observation by reflected light. Between the prisms a piece of fine copper gauze is inserted, which modifies the value of the light in the field observed in the instrument, so that the ratios of light and shade are the same as when lighting by means of transmitted light, making their limits still sharper. By means of this arrangement, it is possible to increase the accuracy of reading in the refractometer, so that one can certainly observe to 0.05°, whereby the accuracy of determining grain by this method is doubled.

Applying the method so elaborated, I determined the amount of fine grain in different molasses from the raw sugar manufacture of the last campaign, the results being collected in the following table:—

R_1		R_2		GRAIN, PER CENT.	REMARKS.
85.27	..	85.25	..	0.13	..
77.6	..	77.6	..	0.0	..
74.8	..	74.8	..	0.0	dilution method, 0.19
80.07	..	80.1	..	0.15	..
79.91	..	79.96	..	0.25	..
84.0	..	84.45	..	2.89	..
85.0	..	85.75	..	5.26	..
75.0	..	76.57	..	6.28	..
81.6	..	83.3	..	9.30	..
78.3	..	80.57	..	10.46	..
82.61	..	84.35	..	11.11	..
78.9	..	81.8	..	13.84	dilution method, 19.50
78.85	..	81.79	..	13.90	dilution method, 18.09
73.2	..	76.79	..	18.70	..

Thus, in many molasses very high figures are shown, the average of all being 6.9 per cent. With the present production of 1,000,000 quintals of molasses, this denotes a loss of 690 wagons of sugar; but whether these figures are abnormally high, can only be established from the average of several years.

Writing on the gasoline (petrol) situation, I. E. KNAPP² says that if the consumption of this motor fuel (4000 million gallons in 1920, according to the American Petroleum Institute) is maintained at its present rate the domestic supply will be exhausted in less than 20 years. "It is safe to predict that when gasoline becomes scarce, alcohol will become plentiful. In the cultivation of starchy plants and their conversion into alcohol lies the hope of our future supply of motor fuel. . . ." He also mentions that a blended spirit (presumably alcohol and petrol with some benzol) is being sold in the States under the name of "Alcogas."

¹ D.Z.I., 1914, 64, 20.

² *Lefac Magazine*, 1921, 2, No. 5 (May), 54-56.

The Presence of Methyl Alcohol in some West Indian Rums.¹

By EDMUND O. VON LIPPMANN.

As the compilation of the few data concerning this subject given in my "Chemie der Zuckerarten" (published in 1904) shows, MARCANO² first stated that he had obtained much methyl alcohol in a peculiar fermentation of sugar cane juice by means of an undetermined yeast. PRINSEN GEERLIGS³ and QUANTIN⁴ thereupon tested a number of fermented cane juices and also rum samples, but without result; while WOLFF⁵ found that the fermented juices of certain fruits contain 0.15 to 0.20 per cent. of methyl alcohol, e.g. those of grapes especially if these are submitted to fermentation together with the skins. Since that time the occurrence of small amounts of methyl alcohol has been confirmed in some kinds of fermented fruit juices (rice spirit, fruit brandy, and rum) by BUCHKA,⁶ BAUER and ENGLER,⁷ as well as TAKAHASHI;⁸ and larger amounts, viz., 1.3-4.2 per cent. in all fruit wines (especially those made from pears) when these are fermented from the residues or mares.⁹

As the result of a visit from Mr. G. STADE (who had previously in the early eighties been chemist at the Duisburg refinery of which I was manager, and who later engaged in many-sided and successful activities in the West Indies), I took the opportunity there and then to propose a solution of the question of the presence of methyl alcohol by means of an investigation on the spot. Soon after his return at that time, Mr. STADE sent me 20 different samples of carefully collected first runnings of rums distilled in Barbados and other West Indian islands, with the remark that they possibly contained methyl alcohol (boiling point, 67°C.). Their testing was carried out by Mr. H. SIBER, who when formerly chemist to Marquardt's drugstore in Stettin had undertaken numerous examinations of rum, brandy, liqueur, etc., and possessed the necessary experience in such work. He made three parallel determinations throughout, namely, with pure ethyl alcohol, with pure methyl alcohol, and with the sample of runnings, using two methods: (1) the old Grodzky-Kraemer's¹⁰ (conversion of the methyl alcohol into methyl iodide by means of phosphorus iodide); and (2) one depending upon the oxidation of the methyl alcohol to carbon dioxide by means of chromic and sulphuric acids, which essentially conformed to that much later worked out by THORPE and HOLMES.¹¹

It was established as a final result that in 3 of the samples the content in methyl alcohol was questionable; in 2 it amounted to 1-2.5 per cent.; in 7 to 2.5-5.0 per cent.; in 5 to 5.0-7.5; and in 3 to 7.5-8.5 per cent. (b.p., 66-67°C.). Of course, these figures are to be regarded only as comparative values; moreover, they do not permit of any kind of estimation being made regarding the original fermented liquids, the amount of which and of the runnings being both unknown. On the other hand, they lead definitely to the conclusion that in the production of such fermented products methyl alcohol is really formed, and indeed in a not inconsiderable proportion.

¹ Translated from the *Biochemische Zeitschrift*, 1920, **106**, 238-238. ² *Comptes rendus*, **108**, 955.

³ *Chemiker Zeitung*, **22**, 100. ⁴ *Journal de Pharmacie*, **IV**, **12**, 505. ⁵ *Comptes rendus*, **132**, 1323.

⁶ *Chemiker Zeitung*, **36**, 1309. ⁷ *Ibid.*, **37**, ref. 328.

⁸ *Journal of the American Chemical Society*, **30**, 2723; *Chemisches Centralblatt*, 1904, 1476; 1909, 642.

⁹ *Chemisches Centralblatt*, **2**, 309 and 1334: 1915, 753.

¹⁰ *Berichte*, **7**, 1492. ¹¹ *Journal of the Chemical Society*, 1904, **83**, 1.

Regarding the question of the manner of its formation, one may consider different possibilities which have been discovered since, for example, the activity of microbes of the type observed by EMMERLING,¹ which produce much methyl alcohol from glycerin, etc.; (2) to the fermentation of glycoll (the presence of which has been identified in cane juices) according to Ehrlich's observation²; or to the reduction of formaldehyde by yeast shown to occur by NEUBERG.³ But the improbability of all these possibilities requires no discussion. On the contrary, the observation communicated by Mr. STADE points in the right direction, namely, that according to experience runnings containing methyl alcohol originate in the greatest amount when the molasses fermented is decidedly acid and very turbid. Since even to-day cane juices in several of the Lesser Antilles are largely obtained by crushing methods of quite an antiquated kind, and since these juices are very insufficiently clarified and mechanically purified, one cannot be surprised that they should for the most part contain considerable amounts of the finest cane fibre, which to a great extent pass over into the syrups and molasses. These more or less swollen-out particles of fibre are rich in pectic substances, and such molasses may easily become contaminated with these constituents far beyond the usual degree. It is now known from the researches of TSCHIRSCH, FELLEBERG,⁴ EHRLICH,⁵ SCHWALBE and BECKER,⁷ and other investigators that the pectins are to be regarded as the methyl esters of the pectic acids; that they contain 9-12 per cent. of this ester (10 per cent. on the average); and that they lose the methyl group in various ways, as, for example, on warming with dilute acids, when it splits off very easily and surprisingly quickly in forming methyl alcohol.

In this way also in the present case the formation of methyl alcohol may arise; and the fact that its occurrence is not observed in Java (as Prinsen Geerligs' experiments show), where extraction and purification stand in an extraordinary high degree, speaks in favour of this view. A true "methyl alcohol fermentation" is out of the question; and therefore for the present one may abandon the term. Other so-called methyl alcohol fermentations demand further examination.

Since instituting the experiments discussed above a rather long time has elapsed, it is true; but seeing that they have not been superseded by other tests (so far as I am aware), they may now be recorded for general information.

Mr. JAMES MILLER, M.I.Mech.E., formerly with Messrs. GEORGE FLETCHER & Co., Ltd., of Derby, has been appointed local agent in Durban for Messrs. JOHN McNEIL & Co., Ltd., of Glasgow.

Giving evidence before the Ways and Means Committee of the House of Representatives when considering the emergency tariff bill,⁸ Mr. F. R. HATHAWAY, of the Michigan Sugar Co., Detroit, said that the cost of production of sugar in the case of his concern was 7.30, 8.90, and 11.88 cents per lb. in 1917, 1918, and 1919. Costs for 1920 had not yet been accurately determined, but would be in excess of 8 cents, while the sugar was actually being sold at 7.50 cents. He expressed the opinion that a duty of two cents on Cuban 96° raw sugar was as low as could safely be imposed, if the integrity of the home-grown sugar is to be maintained. Senator GAY had submitted an amendment imposing a temporary additional duty of 3.768 cents, which would thus make the total duty 6.024 cents, or 4.0192 cents per lb. on Cubas.

¹ *Berichte*, 29, 2736.

² *Landw. Jahrb.*, 1909, Erg.-Ber., 12.

³ *Biochemische Zeitschrift*, 67, 18.

⁴ *Arch. Pharm.*, 252, 538.

⁵ *Chemisches Centralblatt*, 1914, 501; 1915, 753; 1916, 530

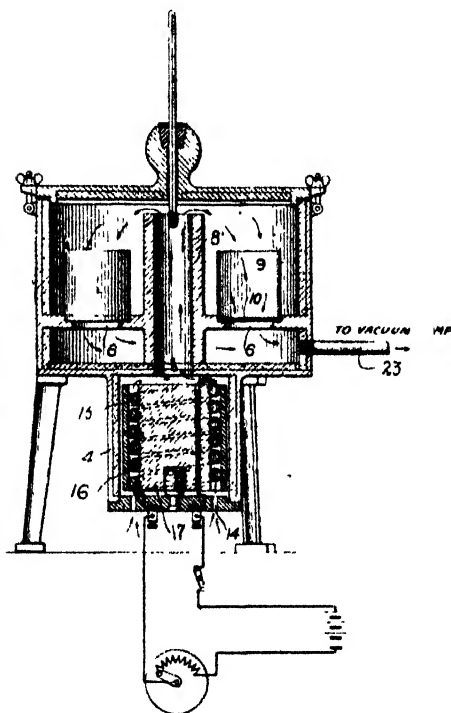
⁶ *Chemiker Zeitung*, 41, 197. ⁷ *Zeitsch. angew. Chemie*, 1919, 127.

⁸ *Facts about Sugar*, 1921, 12, No. 4, 61 and 76-77.

Rapid Determination of Water in Sugar Products, using Dr. Spencer's Improved Electric Oven.

Dr. G. L. SPENCER, in his well-known book,¹ has described an oven for the rapid determination of the water in bagasse and similar materials. He has now improved upon this apparatus, and has patented an electric oven² by means of which an accurate test may be made in less than 10 minutes, whereas ordinarily about three hours may be necessary to effect the same desiccation. Such a rapid result is made possible by drawing a large volume of heated air through the material placed in a cup or capsule with a perforated bottom.

On turning to the illustration (here reproduced from the patent specification), the design of the oven will be readily seen. Air is drawn into the apparatus by means of a vacuum pump attached to 23. It enters through the holes 14 in the



bottom of the heating section 4, which consists of a spiralled resistance 16, wound round a core 17, this heating element being suitably insulated by a collar 15 of non-conducting material, as asbestos. Thus heated, the air passes up the tube 8 and down through the material under analysis placed in the removable capsules 9, 9 (previously tared), the bottom of which is made of Monel metal filter-cloth. Finally the heated air and the moisture evaporated are drawn out of the oven by means of the vacuum pump attached to the pipe 23.

In operating the oven, the service wires are connected in series with a sliding contact rheostat for temperature control, an electric time switch or interval timer, and the heating element. The time switch opens the circuit and rings a bell at the termination of the drying period.

A number of samples of raw sugar were distributed among the laboratories attached to the factories of the Cuban-American Sugar Co.,³ instructions being given to carry out the tests with the new oven, starting with it cold, and drying for 20 mins. at 105° C. Results were obtained by workers with very little laboratory experience which were practically identical with the average of the tests carried out in the control laboratory, demonstrating clearly that the conditions that lead to irregularities are no more in evidence in the new than in the usual type of oven. There is probably less danger of decomposition of the material during desiccation in the new than in other ovens by reason of the very short

¹ "Handbook for Cane Sugar Manufacturers and their Chemists"—Pages 284-286

² U.S. Patent, 1,348,757. NOEL DEERE has also devised an oven operating on a similar principle, though differing from Dr. Spencer's in certain details.

³ See *J. Ind. Eng. Chem.*, 1921, 13, No. 1, 70-72.

heating period and the prompt removal of the vapours. Bagasse is usually dried in the ordinary oven at 110-115°C., but it may be desiccated in the new apparatus at 130°C., or even 140°C. without any appreciable decomposition. A sample weighing 100 grms. and containing 50 per cent. of moisture may be dried in the large oven at 130°C. in 30 mins., the period depending somewhat upon the mechanical state of the material. Samples have been dried at the higher temperature during various periods ranging from 30 to 90 mins. without increase in the indicated moisture.

Regarding the desiccation in this oven of liquid products, a method has been worked out by Mr. GEO. P. MEADE,¹ at the suggestion of Dr. SPENCER. This procedure depends on the absorption by a suitable medium, as asbestos, of the suitably diluted liquid product (e.g., molasses). It is hoped later to give further details of the results obtained by means of this useful drying oven, which enables one to effect such very prompt moisture tests in factory control.

Recent Work in Cane Agriculture.

SUGAR CANE EXPERIMENTS IN THE LEEWARD ISLANDS. REPORTS ON EXPERIMENTS CONDUCTED IN ANTIGUA AND ST. KITTS-NEVIS IN THE SEASON 1918-1919. *Imperial Department of Agriculture for the West Indies, 1921.*

As has been customary for many years past, the experiments are classified under two principal heads, the first containing trials with varieties of sugar cane, while the second includes experiments on the manurial requirements of the crop. Owing to the lack of supplies of manure, however, it has not been possible to carry out the detailed scheme in operation, but experiments on broader lines in liming and green manuring and in tillage operations have been partially substituted. As a result of this disarrangement, it is to be noted that, while the varietal tests are summarized in 50 octavo pages, those on manuring are dealt with in twelve. Only Part I, Experiments with Varieties of Sugar Cane, will be dealt with in this note. As usual the experiments have been carried out on representative estates in the various sugar tracts, and the cultivation and other treatment of the plots has been identical with that of the estate canes. The plots are only one fortieth of an acre in extent, but frequent repetitions are made of each individual trial, and special mathematical study has been devoted to the probable error in the series, the results of which have been published in the *West Indian Bulletin*, Vol. XV, p. 229.

The trials have been made on selected estates throughout Antigua, St. Kitts-Nevis, and this year in Montserrat as well. The canes are grown in single line across the fields, as this is regarded as preferable to rectangular plots, the number of stools per acre varying from 2000 to 2200. By the system of scattered experiments it has proved easy to test newly introduced varieties under different conditions and also to provide the planters with authentic material of seedlings and thus to avoid the danger of mixing the varieties. It has been the almost universal experience that varieties, recommended as the result of experiment by the Agricultural Department, have been found to give satisfactory results when introduced on an estate scale. Only the averages of the different series of experiments are given in the Report: individual results are filed in the office and copies sent to those interested. At the end of each season the results of the year's

¹ Paper read before the Sugar Section of the American Chemical Society, April, 1921.

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working are laid before the local Agricultural and Commercial Society, and the best ten varieties carefully reviewed.

A useful summary description of the best canes (some 70 in number) is tabulated under the headings, Habit, Foliage, Description of Stem, Description of Eye-bud, Arrowing, and General Remarks. The different islands are then treated separately, that of Antigua being taken here as an example. Details are given of the eight estates on which the experiments were conducted, as regards situation, etc., character of soil, and rainfall. The crop export for the island was 12,736 tons of sugar, only 1070 of which was in the form of muscovado. The main set of canes was maintained as usual at Cassada Garden. Plant canes are dealt with first. The average returns (45 varieties) from all the stations during the period under report are given in a table, as yield of canes per acre, sucrose in lbs. per acre, gallons of juice per acre, gallons of juice per ton of canes, and saccharine richness of the juice. The chief varieties are then reviewed in order of merit and a short summary is given of the history and probable usefulness of each. Two other tables are added, giving the results of trials with sugar cane varieties. The first of these gives details of 41 canes grown for longer or shorter periods during the previous twelve years: the number of plots averaged is given for each cane as well as the number of seasons during which it was grown, and the average sucrose in lbs. per acre in juice, is added. Five of these canes are selected for special mention as canes which "can be safely singled out as among the best available for cultivation, as the result of extended trials over a considerable period of time." These five are B 4596, Sealy Seedling, B 6308, B 3922, and B 1528. The second of these tables gives the mean returns of ten varieties which had been under experimental cultivation for the previous eighteen years, the figures representing the mean of from 116 to 185 repetitions of each individual experiment. These three tables thus present a mass of material from which it should not be difficult for each planter to select suitable canes for his special cane tract. But this is not all, for ratoon crops are dealt with in a series of tables of similar nature to the plant cane series, and with the same summarizing remarks. It will be obvious that without these ratoon figures the tale would be incomplete in an island where ratoons occupy so important a position. The St. Kitts cane varieties are treated in a similar way, but with local differences, and it is interesting to note that the order of merit in the two islands is by no means the same. A special feature is the inclusion for the first time of analyses of a successful set of seedlings, raised on Brighton estate, at first 600 in number, reduced by careful selection to 60, and finally, to 17 during the current period, when there were for the first time a sufficient number of holes to test their value. These 17 have thus stood the test of three years' trial and appear to be very promising. Shorter statements are appended as to the experiments in Nevis and Montserrat, but the same excellent system is being carried out in these two islands.

EXPERIMENTS WITH VARIETIES OF SUGAR CANE IN MAURITIUS. *H. A. Tempany.*

Bull. No. 20, (General Series, Department of Agriculture, Mauritius, September, 1920.

This bulletin contains the results of the experiments conducted during the period 1917-19, and it is proposed in future to continue the series from year to year. The range of varieties available to planters in Mauritius is very large and, unless systematic trials are maintained, their relative value cannot be gauged with any confidence. A detailed scheme has therefore been laid down, by which the number experimented on can be kept within reasonable limits by keeping a fixed number under trial and discarding each year the less successful in favour of new

additions. There are at present two Experiment Stations, Réduit at 1000 ft. and Pamplemousses at 200 ft., with minor stations on four estates ranging from 300 to 1300 ft. in elevation. The rainfall and character of soil are given for each of these and they account for a partial survey of the different sugar cane tracts in the island. Four more estate stations are to be laid down to complete the survey.

The more promising seedlings are planted out at one of the chief stations in 6-hole plots and the best increased to 40-hole plots and, from these the most promising are laid down in 60-hole plots on the estates. It is estimated that 200 varieties can be dealt with at Réduit and 100 at Pamplemousses, while on each estate 50 can be reaped as plants and up to third ratoons. Experience has shown that at least 50 lb. samples are needed for analysis and a power mill capable of dealing with 35 such samples is being erected at Réduit where the juices can be analysed at the laboratory. A start was made on these lines in 1917 and the results are regarded as of sufficient interest to warrant a statement concerning them. These results are recorded in two tables. In the first a careful description is given of 83 varieties tested, as to the field characters and botanical details. The field characters are habit, height, foliage, arrowing, canes per stool, size, and colour of cane. The botanical are shape, length, channel, wax of the internode, and the shape of the bud. The second table gives the results of the chemical and mill analyses of 85 varieties, and records the number of trials in each case, the canes in tons per arpent, sucrose per cent. in the cane, and sucrose in kg. per arpent. It is considered that these tables, although not absolutely conclusive and subject to further experiments, indicate a number of canes as decidedly promising and worthy of careful attention. Nineteen have taken a higher position in the returns than *White Tanna* the standard variety. Of these there are three Barbados seedlings, B 3390, B 6308, and B 6450, five from Demerara, D 109, R.P. 6, R.P. 8, R.P. 73, and D 74, while the rest are local Mauritius seedlings. The seedling work in 1917-18 is recorded as follows:—In 1917 approximately 10,000 seedlings were raised in boxes: of these 3436 were planted out for one-hole trials and, of the latter, 525 were placed in 6-hole plots: ultimately 37 were selected for 30-hole plots on the Experimental Station. From these the most promising will be sent for larger trials on the estate stations, and it is hoped that some of them will gradually find their way into general cultivation.

REPORT ON THE SUGAR CANE EXPERIMENTS IN BARBADOS FOR THE SEASON 1918-20. *Department of Agriculture, Barbados.*

This long report of 77 folio pages contains an enormous mass of information in various directions. A great many of the experiments appear to have given inconclusive results, and we rather wonder that the great expense should have been incurred in printing these results in such detail. Part I commences with a useful explanation of terms which should be referred to by all who wish to consult the numerous tables. The composition of the Barbados rainfall during the period is then given, the inches of rain and the number of rainy days in each month, together with the amount of chlorine, nitrogen as nitrate, nitrogen as ammonia, and total nitrogen: these elements show remarkable variations month by month. Another table gives the rainy days and the amount falling in each month on each of the 15 manurial and varietal experimental stations. In Part II the manurial and other experiments are dealt with. The weather was unsatisfactory: the rainfall between November 1918 and January 1919 was very much below the average, so that the canes did not germinate as regularly as usual; and as the drought continued to July it was some time before the crop was established. The rain in

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August was good and the plants greatly improved, but from September till the end of the year it was again below the average. In January 1920 good rain fell but, again, from that time to the end of May very little more was recorded. In view of these facts the crop of the island was expected to suffer considerably. It is well to hold this deficient rainfall in mind when considering what follows regarding insect pests.

Details are then given as to the character and mode of application of the manures. The experiments are divided up as follows :—farmyard manure at the rate of 20 tons and 40 tons per acre; nitrogen series, minerals alone, minerals as before but with nitrogen as sulphate of ammonia, nitrate of soda, and dried blood; phosphate series, nitrogen and potash only, and these with the addition of superphosphate and basic slag respectively; potash series, nitrogen and phosphates only, and these with the addition of potash. The results are recorded in a series of tables, but it is surmised that because of attacks of root borer (*Diaprepes abbreviatus*) and brown hardback (*Phytalus smithi*) "it is impossible to draw any conclusions from them." A long series of discordant results are given to support this contention, one or two of which are here extracted. Plot B 2, with 80 lbs. of phosphate as superphosphate, 60 lbs. of potash as sulphate of potash, and 40 lbs. of nitrogen as dried blood, yielded 728 lbs. less saccharose than the "No Manure" plot. Plots B 7 and B 5 received equal amounts of phosphate and potash, but the former received 40 lbs. nitrogen as dried blood and the latter 60 lbs., but in the end B 7 gave 458 lbs. more saccharose. Plot B 1 which had received 40 tons of farmyard manure every other year for a number of years gave 398 lbs. of saccharose less than Plot A 1 which had only received half the quantity during the same period.

The manurial tables have added columns with the numbers of root borers and hardbacks collected when the old cane holes were dug out. Although this procedure has been followed every year since 1916, these pests appear to be increasing. In 1916, 2305 were found and killed while the figures for 1918 and 1920 were 5962 and 7577 respectively. It is pointed out that these pests have done so much injury to the manurial plots that "the results for the past three manurial seasons are valueless" and it is calculated that the loss per acre has been \$92. In view of these facts a pamphlet was distributed to all the planters in the island calling attention to the pests and making recommendations as to the best means of keeping them in check. As H.E. the Governor wished to know whether these recommendations had been carried out, the Director of Agriculture was instructed to make enquiries, and a form was sent to each estate which had received the pamphlet. This met with a comparatively poor response and, accordingly, the Governor appointed a Commission to enquire into the matter generally. This report was drawn up and laid on the table of the House of Assembly, but it had not been printed at the time of writing and no details are given of its contents.

Other experiments were instituted, to determine the probable error in Barbados sugar cane experiments, and with cuttings from large and small canes, cuttings from canes attacked by moth borer and from those which were free from attack, and cuttings from plant canes and first and second ratoons. The second and third of these experiments were rendered useless by bad invasions of the current insect pests and the last was spoiled by the machinery breaking down in the factory of the estate where the plots were laid; but the results are, all the same, printed in detail in the tables. The experiments on probable error were started in 1912 and, having been continued for nine years, the results are summarized in a table. "The difference for the nine years between the mean yield of the plots which were

highest and those which were lowest amounted to 1.53 tons cane per acre, a difference of 5.11 per cent. Furthermore, the difference between the highest and the average of the four plots for the nine years was + 0.65 tons or 2.11 per cent., and between the lowest and the average — 0.88 tons or — 2.86 per cent. During the nine years plot II which has given the highest yield for five years out of the nine, in one year (1915) gave the lowest yield."

Part III deals with seedlings and other canes, and the insect pests again played a prominent part. The method adopted of raising and selecting seedlings is described. During 1918 some 15,000 seedlings were grown, but a good many of these succumbed to root borer and hardback, although 1175 and 61,814 imagoes of these pests were destroyed respectively. Since 1898 a total of 98,744 sugar cane seedlings have been raised and potted out. Of these, 3298 were under cultivation during the season 1918-20, and 567 variety, manurial and other plots were reaped and the juice from some of the sugar canes analysed. The selected varieties are cultivated on 15 representative estates, after which they are sent to specially selected estates for further trial, where their various characters are thoroughly examined. Full sets of tables are appended to the Report, which may be referred to by those interested, the various seedlings being compared with White Transparent as standard. It is pointed out, however, that the study of the tables must take cognizance of the pests attacking the canes, as these are very unequally distributed among the plots. In dry seasons it appears also that the larvae burrow very deeply, sometimes to 3 ft. or more, and it is probable that in digging the cane holes many have thus escaped capture.

REPORT OF THE AGRICULTURAL DEPARTMENT, ANTIGUA, 1918-19. (*Pests and Diseases.*)

It is again reported that grubs of the hardback beetle (*Lachnosterna* sp.) were common in the majority of the heavy fields in the central parts of the island. Attempts were made to control the pest by maize as a trap crop, and on one estate 125,000 grubs were destroyed in a short space of time. If this method of control were adopted on every estate it would possibly do much good. Reference is made to control by white arsenic mixed with meat works manure at the rate of 14 lbs. of the poison to 112 lbs. of the manure, placed on the ground before planting. In the case of ratoons it is suggested to dust the arsenic on to the trash before cutting, at the rate of 20 lbs. per acre. If soreness develops on the hands, this is quickly removed by washing in "hypo." Frequent surface cultivation at certain times of the year helps to keep the pest under by destroying the young grubs. Investigations are being carried out at the suggestion of the Entomologist of the Imperial Department of Agriculture.

The root disease (*Marasmius sacchari*) is the most serious fungus disease in Antigua. This is commoner and more virulent in seasons of scanty rainfall, and during the recent dry weather the disease was noted throughout the island and undoubtedly did a considerable amount of damage. Some ratoon fields were very unsatisfactory, the growth being indifferent and practically all the plants being attacked. In some cases the cane stools were much more exposed than normally, not appearing to have vigour to develop roots firmly attached to the soil, and this was especially noted in heavy clay which had set hard. One method of fighting the disease is to bring the fields into a high state of fertility, but it is more than probable that the planters do not realize the extent of the damage done by this form of fungus disease. The question also of varieties is very important and should be tested throughout by the planters.

Recent Work in Cane Agriculture.

THE CARE AND TREATMENT OF NEW SUGAR CANE IMPORTATIONS. T. S. Venkataraman and R. Thomas. *Agricultural Journal of India*, Vol. XVI (Part I), January, 1921.

During the three months preceding the writing of this paper no fewer than 170 packages of canes were sent out from the Cane-breeding Station at Coimbatore. The article is written to give wider publicity to the methods to be adopted when such parcels are received. The treatment of the parcel on receipt is first dealt with; many arrive in a damaged condition or contain pieces of cane only just alive, and must therefore be attended to at once. The contents require a most careful inspection for pests and diseases, and this is best done by competent entomologists and mycologists. Quite recently a whole consignment of imported material, apparently quite healthy and rooting and shooting freely, was condemned by the mycologist because it contained traces of fungus rare in India.

The methods adopted for the germination of the material are next described. If properly prepared land is not ready, a useful plan is to build a raised bamboo platform about 3ft. high in the open; on this straw is spread which is sprinkled with a thick solution of cow dung. The pieces are also dipped into this and piled irregularly in a heap, so that air may penetrate; the whole is then covered with straw steeped in the same solution and the mass is kept constantly moist. In 12 days the buds should germinate freely and the pieces will be ready to plant out in about three weeks. But the young plants may be kept on the platform for as long as a couple of months without damage, if the supports are tarred or coated with crude oil emulsion. One of the worst enemies of young cane plants is the white ant, and much study has been devoted to this pest. Generally, thorough cultivation is the best remedy, driving the white ants downwards, but to guard against occasional survivors the sets may be dipped in tarred water (adding the tar drop by drop to boiling water, at the rate of two to three drops to the gallon of water). The trenches should be cleared of all half-rotted manure or bits of trash or vegetable matter and sprayed with a weak solution of crude oil emulsion (1 lb. of emulsion to 10 gallons of water) immediately before irrigation.

Rats are a serious menace in most plantations, and their presence is generally only realized when half a dozen fine clumps suddenly fall after a heavy shower or wind blast. Cleanliness of working and the removal of all hiding places is useful, and when these pests have secured a firm hold, the "white ant exterminator," driving sulphur fumes into the holes, is very effective in bringing them out in a dazed condition. An interesting local method is described which is carried out practically without cost by a set of people who hunt and eat rats, but this method is considered to be only one-eighth as effective as the "white ant exterminator." The paper is illustrated by some interesting plates.

THE CULTIVATION OF SUGAR CANE IN QUEENSLAND. Harry T. Easterby. *Bureau of Sugar Experiment Stations, Queensland. General Series, Bulletin No. 3.*

This full and interesting account of Cane Cultivation in Queensland has been prepared in view of the facts that many planters have recently commenced to grow sugar cane without a great deal of knowledge on the subject, and many others have written to the Bureau for information in taking up land for cane cultivation. In addition, there are proposals for settling many soldiers returned from the war upon sugar lands, and instructions in cane growing will be needed by them when such schemes are given effect to. The bulletin consists of 45 pages of closely printed matter with numerous illustrations. It is very comprehensive

in scope and gives a great deal of information as to the selection and clearing of new land. It is well written and carries conviction on every page and should be of the greatest value, not only to the classes of settlers referred to, but to all who have for years past been engaged in growing sugar cane in Queensland.

SOME LEPIDOPTEROUS PESTS NEW TO SUGAR CANE IN QUEENSLAND. *Edmund Jarvis.* Bureau of Sugar Experiment Stations, Queensland. Division of Entomology, Bulletin No. 9.

Probably the total number of moths and butterflies at present recorded as injurious to sugar cane will fall little short of 100. Seven forms are described in the present bulletin which were not included in the list of Bulletin No. 3 of the same series; these are not all of serious import but are now placed on record as occurring in Queensland. The species described are:—*Cirphis loreyi*, *Mocis frugalis*, *Melanitis leda*, *Padrona hypomoloma*, "Bag-moth" (undetermined but near *Hyalurcta*), *Anthela acuta* and *Ophiura melicerte*. Four of these insects affect cane in other countries and two of them are at times sufficiently injurious to necessitate repressive measures, being closely related to the destructive "army worm."

MONTHLY NOTES ON GRUBS AND OTHER CANE PESTS (THIRD SERIES) 1919-20. *J. F. Illingworth.* Bureau of Sugar Experiment Stations, Queensland. Division of Entomology, Bulletin No. 10.

This is a collection of the monthly typed reports on the progress of the author's researches which have already been widely distributed to the planters and elsewhere. These collected papers deal chiefly with the white grub pest.

FARMING OPPORTUNITIES IN THE UNION OF SOUTH AFRICA. *Compiled by the South African Railway and Harbours Administration (in collaboration with the Department of Agriculture). Publicity Department of the Union of South Africa, Trafalgar Square, London, December, 1919.*

The chief agricultural industries in South Africa have special chapters devoted to them, and that on sugar cane (pp. 42-59) is of special interest in that it deals with the subject in a rather unusual manner. It is of course primarily intended for settlers and the financial and climatic factors are given a prominent place. The claims of Natal proper with its better climate and poorer yield are contrasted with those of Zululand where the climate is more tropical and trying but the crop returns are much better. There appears to be no attempt at hiding the difficulties which are likely to be met, but a good case is nevertheless put up for a successful career with very moderate means for intending sugar planters.

C. A. B.

At a meeting of the Hanover branch of the Verein der deutschen Zuckerindustrie,¹ it was pointed out that furnace ashes may contain 30-50 per cent. of unconsumed coal and coke which may be recovered by magnetic separation. This process is stated now to have passed the experimental stage, having been installed in a large number of plants in Germany, in which it has been proved more efficient and economical than the old method of separating the lighter coke from the heavier mineral matter by floating off in water. Before the war, Germany consumed annually 140 million tons of coal; but this amount is now reduced to half. Assuming that the ash obtained in 20 per cent. of the coal used, and that of this 50 per cent. can be separated magnetically with a 30 per cent. yield, this would result in the recovery of 2.1 million tons. This recovered dust can be burnt either directly or after being made into briquettes.

¹ *Deutsche Zuckerindustrie*, 1921, 46, 94-95, 109-112.

Examination Papers set for the Registration of Chemists in Mauritius.

Only chemists whose names have been placed on the register of the Department of Agriculture are officially recognized in the Courts of Mauritius when certificates of analysis and legal evidence are required. Candidates for registration must either have been in professional practice for a period of 10 years, or else must have passed a preliminary and final examination, the principal subjects of which are agricultural chemistry, sugar-house chemistry and physics, sugar-house chemical control, and bio-chemistry. It is of some interest to note the standard of knowledge required, as shown in the following papers recently set:

Sugar-house chemistry.—(1) Describe as completely as possible the hot sulphitation method in use in Java, and state the advantages claimed. Mention the advantages and disadvantages of sulphiting before liming; of liming before sulphiting; and of liming and sulphiting simultaneously. (2) What are the essential conditions for securing the best operation in milling? A factory has three good mill units and considers installing a fourth. What is your opinion on the acquisition of a fourth unit, as compared with the installation of a crusher? How do you explain the good results given by Messchaert grooves? (3) Why is phosphate of soda added to the defecators in Mauritius (and in other countries)? What disadvantage has this addition? Do you not think phosphate of soda might be replaced by another substance more advantageous? (4) Describe briefly three methods of working massecuite used in Mauritius for obtaining the maximum of white sugar of the first-jet without having recourse to re-melting. Discuss shortly the merits of each of these methods from the points of view of the colour of the sugar and of the quality of the grain. (5) Why does a low-grade massecuite often froth during cooling? How would you prevent this? Give your opinion on the method of feeding a first-jet massecuite in the crystallizers. (6) What are the modern ideas concerning cane factory furnaces from the point of view of the following: (a) dimensions and setting; (b) admission of air; and (c) grate surface? (7) Describe Prinsen Geerligs' theory of the formation of molasses.

Sugar-house control.—(1) Describe clearly a correct method for determining the true solids in a cane molasses. (2) How would you determine sucrose, dextrose, and levulose in a mixture of the three sugars? How do you explain the presence of glucose in cane molasses? What is the action of glucose on Fehling's solution and on polarized light? (2) Describe the methods of SCHEIBLER and of SACHS for correcting the error in polarizing due to the volume of the precipitate when using a solution of neutral lead acetate for clarifying a solution of molasses. (4) How would you determine: (a) the extraction of the first mill; (b) the excess of air in a furnace; and (c) the crystal in a massecuite? (5) An average sample of low-grade sugar gave the following results on analysis: water, 4.20; sucrose, 83.60; glucose, 3.20; and the final molasses had the following composition: water, 20.0; sucrose, 32.30; glucose, 22.60. If you re-melted 80 tons of this sugar, calculate how much white sugar polarizing 100° you should recover assuming the proportion of white sugar to be 96 per cent., and neglecting mechanical and inversion losses. (6) Explain by means of a diagram the different cycles in the cylinder of a steam engine; and state briefly how you would use diagrams for controlling the economy of the steam in a factory.

Candidates were also required to examine and report on samples of sulphate of ammonia; factory scum for fertilizer; and water for boilers.

Chemical Control Results of Mauritius Factories, 1919.

(Compiled by the Société des Chimistes de Maurice.)

FACTORY.

	1	*2	*3	*4	5	6	7	*8	*9	*10	11	12	*13	*14	15	*16	*17	*18	19	*20
Sucrose, per cent. of the cane.....	12.43	12.75	12.80	13.02	13.03	13.04	13.05	13.08	13.20	13.24	13.29	13.32	13.34	13.35	13.35	13.45	13.48	13.59	13.68	13.77
Fibre, per cent. cane.....	11.81	12.84	12.55	13.12	13.13	13.14	13.15	13.16	13.17	13.18	13.19	13.20	13.21	13.22	13.23	13.24	13.25	13.26	13.27	13.28
Density, first mill juice, Brix.....	17.50	18.17	18.23	18.35	18.36	18.37	18.38	18.39	18.40	18.41	18.42	18.43	18.44	18.45	18.46	18.47	18.48	18.49	18.50	18.51
Sucrose, per cent. first mill juice.....	15.41	15.75	15.86	16.35	16.36	16.37	16.38	16.39	16.40	16.41	16.42	16.43	16.44	16.45	16.46	16.47	16.48	16.49	16.50	16.51
Apparent purity, first mill juice ..	86.0	86.8	87.5	86.4	86.8	86.2	87.5	87.4	86.5	86.2	86.4	87.4	87.5	86.8	86.0	87.1	87.8	88.3	88.5	89.4
Density, mixed juice, Brix.....	15.92	14.91	15.08	15.94	15.26	15.56	14.83	15.56	16.73	16.61	17.10	15.09	16.50	16.01	16.85	15.54	15.56	15.34	15.20	15.20
Sucrose, per cent. mixed juice	12.95	12.77	12.82	13.43	12.91	13.05	12.49	13.94	14.36	14.36	14.32	13.59	14.99	13.70	13.95	12.90	12.16	12.07	11.84	11.84
Glucose, ratio of mixed juice	4.8	4.0	5.1	3.0	4.6	5.5	4.0	5.0	5.0	3.3	4.5	3.6	2.6	5.3	3.9	3.5	4.4	3.9	2.8	3.6
Apparent purity of mixed juice	81.3	85.6	85.0	84.3	84.6	83.9	83.6	84.1	85.8	86.5	83.4	84.5	85.1	85.6	82.7	82.9	85.6	84.1	85.9	87.7
Mixed juice, per cent. cane.....	—	93.3	—	89.3	93.1	92.3	97.4	85.6	88.6	91.3	85.2	91.4	87.0	90.4	88.4	90.1	95.9	—	85.5	94.0
SO ₂ , grms. per litre of sulphited juice	1.19	0.99	0.88	0.76	1.12	0.76	1.02	0.75	1.03	0.90	0.85	1.00	0.81	1.00	0.81	1.00	0.88	0.87	1.19	0.70
Density, last mill juice, Brix	8.68	6.03	5.42	7.34	5.16	7.26	4.83	3.33	7.28	4.40	9.65	7.13	8.54	8.63	7.28	3.62	5.62	6.73	9.97	6.50
Sucrose, per cent. last mill juice	6.66	4.94	3.88	5.80	3.99	5.81	3.46	6.47	5.88	3.56	7.87	5.70	6.84	6.74	5.58	2.51	4.27	5.21	8.04	5.13
Apparent purity, last mill juice	76.6	22.0	71.7	79.0	77.3	80.3	71.7	77.0	78.7	80.9	79.1	80.0	80.1	78.1	76.6	69.3	75.9	77.5	80.6	78.4
Apparent purity of dehydrated juice.	82.2	84.2	85.5	84.7	84.6	83.9	83.2	—	84.8	87.1	85.0	85.4	85.2	78.6	83.4	83.3	86.0	84.7	85.9	87.3
Macération, per cent. cane	—	18.1	—	14.7	22.3	17.6	22.4	—	15.4	12.1	8.4	15.2	13.1	13.9	12.1	22.5	21.8	—	11.1	21.6
Dilution of normal juice, per cent. by weight.....	—	21.2	21.0	19.8	34.6	—	26.8	13.0	17.8	—	10.9	16.7	17.7	15.6	12.7	21.1	22.5	—	12.0	25.4
Sucrose in bagasse, per cent.....	3.31	3.18	3.17	3.58	3.44	3.96	3.34	4.20	4.53	3.24	4.05	3.76	3.65	4.02	4.25	2.86	3.54	3.31	4.67	4.41
Moisture in bagasse, per cent	45.0	44.0	43.2	45.5	45.5	44.5	43.5	44.6	43.5	42.8	44.8	44.8	44.7	43.2	43.1	44.6	42.1	44.6	42.1	46.6
Fibre in bagasse, per cent	50.03	51.80	51.46	49.57	50.42	50.57	50.46	48.46	47.0	50.42	50.21	50.75	51.20	51.50	52.02	50.60	53.63	47.29	46.40	46.40
Sugar lost in bagasse, per cent. cane	0.90	0.78	0.84	1.01	1.02	1.00	0.99	1.09	1.21	0.74	1.07	0.89	1.05	0.84	1.01	0.67	0.92	0.76	1.19	1.22
Bagasse, per cent. cane.....	23.6	24.8	26.3	28.5	29.1	25.3	25.8	26.1	26.8	27.8	23.76	23.72	29.09	23.50	23.73	23.49	25.04	23.10	25.64	27.50
Sugar in scums, per cent.....	8.52	7.93	8.66	7.14	7.07	9.03	8.97	8.28	8.01	9.00	7.18	10.72	7.70	7.23	8.20	7.97	7.60	7.21	9.19	6.90
Scums, per cent. cane	—	2.2	—	2.0	—	1.5	1.25	—	1.36	1.75	1.74	1.80	2.00	1.50	2.03	—	1.56	—	2.00	1.70
Brix of evaporator syrup	53.0	61.6	58.2	48.1	57.9	59.4	53.5	50.9	51.0	51.2	51.8	54.0	55.8	46.0	49.2	55.4	53.2	57.8	51.8	51.1
Purity of conc'd evaporator syrup ..	83.7	83.6	83.6	85.3	85.1	80.8	82.8	83.2	83.9	86.2	82.0	84.6	85.4	81.9	83.5	83.6	81.4	80.6	85.9	86.6
Evaporation, per cent. by volume of dehydrated juice	73.0	—	—	69.5	78.0	70.9	75.2	70.8	71.7	71.8	70.9	71.5	73.7	67.6	68.5	75.5	73.0	75.2	70.8	70.1
Purity apparent of first massecuite...	78.5	68.8	—	80.0	68.3	83.2	76.2	81.3	84.3	84.3	83.0	87.3	80.9	—	76.6	73.8	71.9	84.7	78.6	70.1
Brix massecuite from pans	—	94.1	95.2	93.2	94.4	94.8	94.8	94.8	93.9	94.3	94.6	94.6	91.7	—	96.9	97.1	94.0	96.0	96.5	93.7
Normal juice per cent. cane	79.4	77.2	76.6	74.5	74.7	70.7	76.2	75.9	75.2	76.8	73.2	73.9	78.5	78.5	81.8	78.2	78.2	78.9	76.4	75.6
Extraction.....	92.8	93.8	93.5	92.2	92.2	92.3	93.2	91.7	90.8	94.4	91.9	93.3	92.0	92.8	92.4	95.0	93.2	94.4	91.3	91.1
Veau sugar, per cent. cane	9.99	10.19	10.26	9.70	10.35	9.75	9.96	10.01	9.32	10.64	10.69	10.51	10.33	9.52	10.73	10.30	10.73	10.30	10.53	10.53
Product sugars, per cent. cane.....	0.21	0.47	0.25	0.49	0.37	0.57	0.76	0.42	0.46	0.41	0.51	0.33	0.69	0.83	0.48	0.38	0.43	0.51	0.51	0.41
Total sugars, per cent. cane.....	10.20	10.66	10.51	10.19	10.72	10.32	10.72	10.43	9.78	11.07	10.60	10.84	11.02	10.35	10.52	11.11	10.73	11.32	10.90	11.33
Total sugars, per cent. sugar in juice ..	82.5	89.0	87.9	84.8	86.6	85.7	88.1	86.8	82.6	88.6	86.7	87.2	89.7	83.5	85.2	86.9	85.4	88.2	87.3	89.4
Total sugar, per cent. sugar in cane ..	82.1	83.6	82.1	78.3	82.8	79.1	83.1	80.9	77.7	86.7	82.1	84.0	82.6	77.8	76.8	82.6	79.6	83.3	87.3	89.4
Veau sugar, per cent. sucrose in juice ..	—	85.1	85.1	80.8	86.4	81.0	81.3	79.9	77.7	86.7	82.1	84.0	84.0	76.7	81.2	83.9	83.0	84.2	86.2	86.2
Apparent working loss per cent. cane ..	1.33	1.31	1.45	1.62	1.22	1.72	1.44	1.57	2.21	1.43	1.62	1.59	1.26	2.06	1.82	1.67	1.97	1.51	1.59	1.33

FACTORY.

	1	*2	*3	*4	5	6	7	*8	*9	*10	11	12	*13	*14	15	*16	*17	*18	19	*20
Total apparent loss, per cent. cane	2.53	2.09	2.29	2.83	2.24	2.72	2.83	2.66	3.42	2.17	2.69	2.48	2.32	3.00	2.83	2.34	2.89	2.27	2.76	2.54
Average polarization of sugars	—	—	99.0	98.0	—	98.3	97.8	—	—	99.0	98.0	99.0	98.5	98.2	98.3	98.4	98.7	98.7	—	98.4
Molasses, per cent. cane	—	—	—	2.67	2.65	3.00	—	—	—	2.7	—	2.37	2.65	—	—	—	—	—	—	—
Clerget purity of molasses	31.8	—	34.0	29.6	38.4	40.2	41.4	37.2	—	38.0	39.0	34.0	38.2	—	39.8	38.7	36.3	37.6	—	35.6
Sulphur, kg. per ton of cane	—	0.74	0.88	0.43	0.38	0.46	0.61	0.60	0.65	0.72	0.72	0.88	0.58	0.76	0.61	0.60	0.30	0.47	0.65	0.63
Lime, kg. per ton of cane	—	3.02	1.98	1.23	1.49	1.30	1.60	1.67	1.12	3.2	2.6	2.30	2.77	1.64	3.10	1.90	2.39	—	0.76	1.80
Superphosphate, per cent. cane	—	0	0.12	0.003	0.07	—	0.003	—	—	—	—	—	—	—	—	—	0.09	—	—	—
Phosphate of Soda, per cent. cane	—	0	—	—	0.09	—	—	—	—	—	0.16	—	—	0	—	0.15	—	—	—	—
Bagasse calculated to Cardiff coal, kg. per ton cane per hour	—	57.8	—	—	60.6	—	60.1	57.1	57.4	50.5	68.4	53.7	—	54.2	55.0	54.6	59.0	—	—	57.0
Extra fuel, per ton cane per hour	—	—	—	—	—	—	4.5	6.3	—	3.9	—	3.6	—	11.8	29.4	0.4	0.06	—	—	0.1
Total fuel, calculated to Cardiff coal per ton cane per hour	—	—	—	—	—	—	64.6	63.4	—	54.4	—	57.3	57.1	66.0	84.4	75.0	59.06	—	—	57.1
Average hours working of mills per 24 hours	13.23	12.73	—	14.25	16.28	14.00	18.1	19.8	15.1	18.3	14.2	11.6	13.0	12.6	17.1	14.6	24.0	14.0	18.2	22.1
Defecator capacity, cub. metres per ton of cane per hour	1.42	1.25	—	1.13	1.07	—	3.05	1.62	1.33	1.65	—	1.10	1.37	1.58	2.03	1.31	2.02	1.32	1.76	2.50
Defecated juice, cub. metres per ton of cane per hour	0	0	—	0.39	1.00	—	0.72	—	0	0.85	—	0.65	1.06	0	2.10	0	—	—	—	—
Evaporator Syrup, cub. metres per ton of cane per hour	3.23	1.94	—	2.52	3.20	—	3.33	2.15	2.33	2.20	—	3.06	3.89	2.10	3.20	1.16	2.03	1.41	1.80	1.80
First molasses, cub. metres per ton of cane per hour	1.28	5.98	—	2.40	1.69	—	0.74	—	2.02	2.37	—	0.94	3.73	3.65	2.80	0.87	0.94	2.37	1.75	5.20
Low grade molasses, cub. metres per ton of cane per hour	0.71	—	—	0.80	1.60	—	4.45	—	2.46	0.44	—	1.70	1.46	0.93	—	3.49	2.68	0.94	2.46	1.10
Crystallizer capacity, cub. metres per ton of cane per hour	8.82	7.75	—	10.50	7.14	—	11.07	13.86	9.04	10.30	—	8.70	12.18	9.57	12.70	6.86	7.68	5.78	11.60	16.90
Pans, capacity cub. metres per ton of cane per hour	1.42	—	—	—	1.46	—	1.80	2.20	0.96	1.20	—	1.33	1.16	—	—	0.90	—	1.39	2.09	1.90
Filter - press filtering surface, sq. metres per ton of cane per hour	2.19	1.30	—	1.60	0.71	—	—	10.37	1.89	2.01	—	1.90	1.81	2.82	—	0.91	2.24	2.12	1.27	5.80
Juice-heater heating surface, sq. metres per ton of cane per hour	5.42	7.52	—	5.30	8.27	—	10.2	13.78	4.66	7.20	4.6	7.2	6.6	7.12	—	6.93	2.76	2.64	11.10	13.10
Defecator heating surface, sq. metres per ton of cane per hour	1.29	1.29	—	1.40	—	—	—	0.93	1.58	1.40	—	1.40	1.68	1.51	—	0.79	—	1.32	—	—
Evaporator heating surface, sq. metres per ton of cane per hour	16.8	30.0	—	19.7	30.9	—	24.3	23.8	22.1	24.1	18.2	19.5	15.8	23.2	—	16.7	38.5	20.9	23.9	27.4
Pan heating surface, sq. metres per ton of cane per hour	6.75	—	—	—	5.80	—	—	5.35	5.33	9.40	3.2	5.4	—	—	—	3.81	6.01	—	—	9.4
Boiler heating surface, sq. metres per ton of cane per hour	34.6	33.8	—	32.4	35.9	—	33.2	61.7	32.6	37.2	32.7	29.8	33.7	32.2	—	32.5	41.3	42.4	54.4	47.0
Grate surface, sq. metres per ton of cane per hour	0.45	0.47	—	0.24	0.41	—	—	0.66	0.43	0.55	—	0.50	0.26	0.56	—	0.41	0.63	—	0.60	0.40
Ratio of boiler heating surface to grate surface	75.9	71.6	51.4	135.0	87.6	—	—	93.5	87.5	67.6	—	59.6	124.5	57.5	—	80.0	68.6	—	90.7	117.6

Results of 17 factories are here reproduced. Altogether 20 took part in the Mutual Control. Factories marked * practiced the double polarization (Clerget) method of determining sucrose in their products. One factory applied a factor for converting the direct polarization into the Clerget value. Some factories use 144.0 as the Clerget constant, while a number of others apply a constant in the selection of which the concentration of the sugar

Correspondence.

BAGASSE CARBON.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—In your March number (page 167) Mr. MORIZ WEINRICH comments upon an abstract of my German Patent No. 322,135, of June 17th, 1920, which was published in your January issue (page 54); and concludes that the claims of the said patent are void.

It is regrettable that Mr. WEINRICH has such a perfunctory way of discussing a subject. In this instance he could only have had a superficial knowledge of the case, for the claims of my patent were not published.

I can therefore only reply to Mr. WEINRICH by advising him first to study my patent and its claims before making any comments.

Yours faithfully,

J. SAUER.

[*.* We think that Mr. Sauer's particular method of applying bagasse carbon to the purification of cane juices was quite clearly stated in the abstract referred to above, as those interested may be able to judge from the statement of Claims 1 and 2 of the invention in question which read as follows: (1) Process for the treatment of sugar juices and the like characterized by treating these liquids first by means of a so-called pre-treatment carbon prepared from bagasse or beet pulp by dry distillation in closed retorts, and then with finely powdered so-called decolorizing carbon. (2) Method of carrying out the process described in Claim (1) characterized by using as the so-called decolorizing carbon a material obtained, either from the pre-purification carbon by treatment with hot gases in the absence of air, or else directly from bagasse or beet pulp by heating in the absence of air and at the same time passing in hot gases.]

Publications Received.

Condensed Description of the Manufacture of Beet Sugar. Franz Murke,

Ph.D., A.M. (Chapman & Hall, Ltd., London.) 1921. Price: 15s. net.

Dr. MURKE, we think, might have given his useful book some such title as "*The Practice of Beet Sugar Manufacture*," in order more precisely to indicate the nature of its contents, for it is essentially a practical work. It is a guide-book for the superintendent, engineer, and chemist in the routine of the various stages of the making of sugar in the modern American beet house. It deals less with the theoretical principles underlying extraction, clarification, and boiling than with the actual performance of the details involved in these operations. Dr. MURKE has in fact put on paper for the benefit of his colleagues those methods of working which many years' experience has shown him to be productive of the best results; and he observes details of technique which hitherto (excepting in Dr. Claassen's excellent volume) have generally been only incidentally and inadequately discussed.

Books on technique are always appreciated by the practical man; and this one forms a welcome addition to the literature of our subject. Special features are (1) the advice given for the avoidance or mitigation of the irregularities that are liable to occur during diffusion, carbonatation, and boiling; and (2) the useful notes that appear here and there on points such as the capacity of the plant in houses slicing a certain quantity of roots, the composition and purity of the various products at different stages, the fuel consumption and water requirement, etc. Although the book relates to beet sugar manufacture, and very particularly to American beet practice, nevertheless the cane technologist will find something useful in the work. Most sugar men, for example, will read the sections on filter-press work and on boiling with some interest.

Publications Received.

Cocoa and Chocolate: their Chemistry and Manufacture. Revised and enlarged by R. Whympers. Second edition; with 16 plates and 38 test figures. (J. & A. Churchill, London.) 1921. Price: 42s. net.

Mr. Whympers's book has now attained the position of being regarded as a standard work of reference dealing with cacao from its growth to its manufacture into cocoa or chocolate. In its first edition it served the useful purpose of putting before the maker the ways and means of securing a desired product, and in providing scientific reasons for the development of flavour and consistency. This second edition, while planned very much on the same lines as the first, has been re-written, revised in parts, and enlarged. It is now a very comprehensive treatise, dealing with (1) the history, botany and agriculture of cacao; (2) the manufacture of chocolates and cocoa powders; and (3) the chemistry of cacao, surveying the components of cacao, cocoa and chocolate, and reviewing methods of analysis of raw materials and finished preparations. A number of new illustrations of plantation operations and factory machinery have also been added, and with these additions and emendations the book now forms a valuable general treatise on the subject, which should certainly be in the hands of all interested in this industry.

An Introduction to the Chemistry of Colloids.¹ Dr. Victor Pöschl. Translated from the Second German Edition by H. H. Hodgson, M.A. (Charles Griffin & Co., Ltd., London, W.C. 2.) Price: 4s. net.

Those realizing the importance of colloidal chemistry, and desiring to become acquainted with this branch of science, have in this book (which has just been reprinted) a useful short compendium of the subject. It gives in concise form a summary of the present position of the properties and preparation of colloidal solutions; the relation of colloidal solutions to solutions proper and to suspensions; the dispersoids and their classification; recent views on the nature of the colloid state; and lastly the importance of colloidal chemistry in industry and technology. It is perhaps the best general elementary manual which may be recommended to the chemist who preliminarily desires to acquire the most essential knowledge concerning colloids before taking up works that deal more exhaustively with the several phases of this development, which is undoubtedly of increasing importance.

Proceedings of the Chemical Engineering Group of the Society of Chemical Industry. Volume I. (Chemical Engineering Group, 24, Buckingham Street, Strand, W.C. 2.) Price: 10s. 6d.

Its contents include: Production of steam from low-grade fuel, P. PARRISH, A.I.C.; Economic management of small boiler plants, J. W. HINCHLEY, A.R.S.M., F.I.C.; General types of pumping machinery, J. H. WEST, A.C.G.I.; Kestner's automatic elevator, J. ARTHUR REAVELL, M.I.M.E.; etc.

Wendt's Electro-Titration Apparatus. Bulletin No. 86 of 1920, (Central Scientific Co., 460, E. Ohio St., Chicago, U.S.A.) Free on application.

References have recently been made in our pages to new methods of determining the hydrogen ion concentration of raw sugar or liquors in process.² This is an interesting pamphlet giving directions for "accurately determining the end-point in chemical titrations"; and for obtaining "a true end-point regardless of the presence of colour, turbidity, precipitates, complex salts, weak acids or bases." Electro-titration is suited for routine tests; and it does not demand any great degree of skill once the procedure in the case of any type of solution has been standardized. It is a matter of some interest to the sugar factory or refinery chemist, as one will realize by the perusal of the literature of the subject, to which this contribution forms a useful introduction.

¹ A fifth German edition has now appeared under the title of "Einführung in die Kolloidchemie" (Theodor Steinkopff, Dresden), 1919.

² I.S.J., 1921, 103, 165, also "Electrometric Methods and Apparatus for determining Hydrogen Ion Concentrations"; Catalogue No. 75. (Leeds & Northrup Co., 4901, Stenton Ave., Philadelphia, Pa. U.S.A.)

Brevities.

Prof. F. G. HOPKINS has been appointed to the recently established Professorship of Biochemistry at Cambridge University.

Bagasse paper for mulching in cane fields in Hawaii is now being turned out in large quantity at the Olaa mill.¹ A heavier and stronger grade is also being made for the pineapple fields in Oahu, 40 per cent. of spruce or sulphite pulp being added to the bagasse pulp.

A patent has been taken out by J. A. VIKLE and H. PLAUSON² for the production of hydrocarbons of low boiling point (such as might serve for motor fuel) by heating carbonaceous materials, as coal, peat, or tar oils, under pressure with an alkali in the presence of hydrogen.

Mr. FRÉDÉRIC MARTIN³ in a recent article urges manufacturers in Mauritius to utilize their molasses for the production of an alcohol-ether motor fuel ("Natilite"), to replace petrol for driving the large number of motor cars in the Colony. He advocates this fuel also for the use of agricultural motor tractors.

During 1920 the Californian and Hawaiian Sugar Refining Co.'s refinery at Crockett maintained a daily output of 1468 tons; but its capacity is being increased to no less than 2000 tons with provision to enlarge to 2250 tons per day.⁴ This refinery will be able to melt the entire production of the Hawaiian Islands.

It is reported that a plant for the production of alcohol for motor fuel ("Natilite") is to be established at Hawi plantation, Hawaii, T. H., and is to be similar to that at L'aia, Island of Maui.⁵ About 800 gallons will be produced daily at a cost of not more than 20 cents. per gallon, that is, 8-10 cents cheaper than gasoline.

A mixture of betaine (a nitrogenous base occurring in beet juice) and a solution of an easily soluble, preferably hygroscopic, salt has been found in Germany to prove a useful substitute for glycerin for many purposes.⁶ Thus, 180 parts of calcium chloride are dissolved in 350 parts of water, and 465 parts of betaine added.

Mr. CECIL F. TIMMAN recently read a paper⁷ on the work done to date in regard to the production of alcohol from ethylene recovered from coke-oven gas.⁸ Among the more important matters dealt with, that of the impurities in the alcohol obtained by this process was mentioned, it being found that repeated distillations of the 80 per cent. spirit left a residue which had been identified as diethylene disulphide. In addition to this impurity, a yellow oil had been found on the surface of the weak distillate, but its nature does not appear to have been established. "That pure alcohol can be made from coke-oven gas was certain, but that it could be made economically was to be shown."

G. E. G. VON STIETZ⁹ says regarding sugar manufacture in Java that "notwithstanding the price of labour and materials having increased about 100 per cent., most of the factories are still able to produce 1 picul (61 76 kg.) of sugar at about 10-12 guilders, or 1 ton at about 160-200 guilders, equivalent to 8 guilder cents, or to 3-4 dollar cents per lb. avoirdupois." These costs (in F. per ton) are divided by him as follows: land rent, cultivation and cane transport, 96; cost of manufacture including packing, 48; upkeep of buildings and machinery, 16; transport of sugar to the coast, 8; interest, bonus, commissions, etc., 24; a total of F. 192 per ton.

Writing on the cost of production of beet sugar in Czecho-slovakia, Fr. ZVERINA¹⁰ states the present cost of 1 quintal of roots to be 30 crowns; transport to mill, per 100 kg. 1.16 crowns; and 1 quintal of coal, 100 crowns. Prices of materials in crowns in 1914-15 and in 1920-21 per quintal are: coke, 3.8 and 105; sacks, 0.90 and 30; oil, 0.60 and 15; and cloth (cotton), 1.58 and 110. Some costs of plant in crowns in 1915 and 1920 are: battery of 16 diffusers, 56,600 and 1,031,200; vacuum pans, 115 sq. m., 21,000 and 390,000; and steam engines, 150 H.P., 14,000 and 239,000. "This enormous increase in production costs represents a great danger for the future, and beet sugar perhaps will be unable to contend with the competition of cane sugar. . . ."

¹ I.S.J., 1919, 349.

² U.K. Patent, 180, 789.

³ Bulletin de la Société des Chimistes, 1912, 12, No. 42, 57-64.

⁴ Facts about Sugar, 1920, 11, No. 25, 491.

⁵ I.S.J., 1921, 84.

⁶ Gorman Patent, 328, 530.

⁷ J. S. C. Ind., 1921, 88-89T.

⁸ Chemical Trade Journal, 1921, 68, No. 1764, 343-344.

⁹ I.S.J., 1920, 168.

¹⁰ La Planter, 1921, 66, No. 10, 159.

¹¹ Facts about Sugar, 1921, 12, No. 4, 69.

Review of Current Technical Literature.¹

DATA CONCERNING SOME REFINERIES IN FRANCE AND ENGLAND. *T. H. Murphy. Louisiana Planter, 1920, 65, No. 26, 410-411.*

Major MURPHY (formerly of the Chemical Warfare Service, A.E.F.) while in Europe in 1919 visited a number of refineries in France and the United Kingdom, and made a report on the equipment inspected, from which the following notes are taken: Say's house at Paris melts daily 700-800 tons of sugar (mostly the coarse practically white crystals from the French beet factories but also some high-grade Cuban raws), working all this up to cubes made by the Adant system. Preliminarily the raw sugar is treated by a slow process of washing by gravity and suction, using 44 batteries and 880 filtering wagons. After melting, the liquor (said to be at about 36° Bé. or 66° Brix) is filtered over excelsior presses, heated up in old pans carrying a vacuum of about 8 in. of mercury, and sent over char. Decolorizing carbons have been tried in place of char, but found to be impossible to revivify economically. A very hard grain is boiled, and one pan was noted to be at 95° C. (203° F.) before dropping. In the Adant moulds the massecuite cools and crystallizes during 18 or 20 hours, forming plaques about $\frac{7}{8}$ in. thick, 1 ft. wide, and 2 ft. long, which are spun in centrifugals, and washed with a heavy white solution and some blue. It is said that about 85 per cent. of the sugar slabs produced is in the form of cubes; 2 per cent. is sawdust; 6 per cent., fine and coarse screenings; and about 7 per cent., coarse lumps. Boilers, engines and electrical equipment in this refinery are splendid. Lebaudy Frères' and Sommier's houses were also visited, as well as a number of others.

In regard to English refineries, it is said that Messrs. Fairrie & Co., of Liverpool, operate a char house of 24 filters of 30 tons capacity each with only 10 men on each shift, and revivify all their char every three days. Their cube sugar plant was made by a firm at Lille, and they have done much experimenting with "Norit," "Blankit," etc., but believe that as yet nothing is better than kieselguhr and animal charcoal. Messrs. Abram Lyle and Sons have "a very nice plant," and are said to melt about 500 tons per day. Some particulars are given regarding their water-side accommodation, and their method of unloading the raw sugar from the barges. "This refinery has installed four self-discharging centrifugals . . . and (it is here stated) they washed so much and spun their sugar so dry that it would not fall out of the basket, so they converted the machines to the ordinary type, attached unloaders, and decided that the self-discharging was a failure." Messrs. Henry Tate & Sons melt 700 tons per day, and their raw sugars are washed in 15 self-discharging centrifugals with a 48 in. basket, 24 in. deep, taking about 15 cub. ft. of massecuite, each discharging over 700 lbs. of washed sugar with not more than 2.5 per cent. of moisture. These machines work very satisfactorily. They treat their liquors with milk-of-lime, then carbonate with the washed kiln gases, much as in a beet sugar factory, filtering with the addition of kieselguhr through Sweetland filters. They use about 600 tons of char, and revivify twice per week in ordinary Scotch kilns. Very poor coal was being used at the time, and it was necessary to burn about half a ton per ton of refined.

RE-TESTING THE 100° POINT OF THE SACCHARIMETER: (1) DETERMINATION OF A SMALL AMOUNT OF INVERT SUGAR IN THE PRESENCE OF MUCH SUCROSE. *Anton Kraiszy. Veretins-Zeitschrift, 1921, No. 732, 123-144.*

According to the work carried out by BATES and JACKSON,² the rotation value for the 100° point of the saccharimeter established by HERZFELD and SCHÖNRÖCK,³ used at present in the standardization of most instruments, is about 0.1 per cent. too high. In order to investigate this question, it is first necessary to elaborate a method of determining about 0.005 per cent. of invert sugar in the sucrose used, since, owing to the high *levo*-rotation of this impurity, even a small amount may be capable of causing an error that cannot be

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

² *I.S.J.*, 1912, 580; 1917, 380; see also 1919, 520. ³ *Veretins-Zeitschrift*, 1900, 826; 1904, 521.

regarded as negligible. Ordinary Fehling's solution is insufficiently sensitive for the purpose; Soldaini's reagent, while worthy of recommendation for qualitative tests, is not preferable to Fehling's solution for quantitative work; while by means of Ost's liquor it is impossible to determine less than 0.02 per cent., as recent work by BREYERSDORFER¹ has shown. After experimenting unsuccessfully with solutions of silver and mercury salts, and also examining the possibility of colour reactions, such as those produced with *p*-diazobenzenesulphonic acid, picric acid, etc., it was decided that a neutral solution of cupric carbonate in Rochelle salts forms the most satisfactory reagent, one which had been shown by HERZFELD in 1879 to produce a precipitate of cuprous oxide with dextrose, though not with sucrose.

This solution was therefore used. But in order to avoid the necessity of filtering off the cuprous oxide (and of thus risking error, owing to the incomplete separation of the very fine precipitate), the amount of reduction occurring was ascertained volumetrically by oxidizing the Cu_2O in acid solution with iodine, and back-titrating the excess of iodine with thiosulphate². Shortly before use, 25 c.c. of a solution containing 2 grms. of copper (7.86 gm. of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) in a litre are mixed in a 250 c.c. Erlenmeyer flask with 25 c.c. of a solution containing 3.292 grms. of sodium carbonate and 20 grms. of Rochelle salts in a litre. At the same time, in a second Erlenmeyer flask, 50 c.c. of the sugar solution (containing 10 grms. of sucrose) are mixed with 5 c.c. of N/10 potassium bicarbonate (10.01 grms. KHCO_3 per litre). Both solutions are heated to boiling, so arranging the heating (on an asbestos-gauze plate) that the copper solution is already boiling when the sugar solution is just beginning to do so. At this moment the first solution is added to the second (which is not removed from the plate), and timing from the moment of mixing, boiling is continued for exactly 10 mins. At the end of this period heating is discontinued, and the liquid cooled by adding 50 c.c. of cold (recently boiled) distilled water, taking care while doing this that air bubbles are not produced. After standing the flask in cold water for about 5 mins., 1-1.25 c.c. of 4/N hydrochloric acid is run in and immediately after a sufficient amount of standard iodine solution while carefully mixing, the excess remaining being then titrated by means of standard thiosulphate solution with starch as indicator, as usual. It is said that the thio addition should be continued drop by drop until the decolorization remains permanent after 1 or 2 mins., and that the titre of the iodine solution should be such that 1 c.c. = 1 mgrm. of Cu (that is, N/63.57). Under the conditions of working specified, each mgrm. of invert sugar in the presence of 10 grms. of sucrose converts 2.3 mgrms. of Cu from the bivalent (cupric) to the univalent (cuprous) combination. Two other points that were established were: (1) That when the invert sugar content is less than 0.05 per cent., and the sucrose less than 10 grms., the amount of copper reduced is proportional to the amount of invert sugar actually present; and (2) that the error which results on increasing or decreasing the duration of boiling by $\frac{1}{2}$ min. is equivalent only to 0.4 mgrm. On examining refined sugars which had been purified by precipitation with alcohol, the copper (Cu) in mgrms., using this so-called neutral Fehling's liquor, varied between 1.5 and 4.6; using Striegler's reagent, 5.4 and 9.2; and using ordinary alkaline Fehling's solution, 36 and 43, which results show quite clearly that neither of the latter two reagents is capable of detecting less than 0.05 per cent. of invert sugar, whereas the neutral liquor is said to be sensitive to 0.002 per cent. in the presence of 10 grms. of sucrose.

OPTICAL ROTATION OF MIXTURES OF SUCROSE, DEXTROSE AND LEVULOSE. W. C. Vosburgh. *Journal of the American Chemical Society*, 1921, 43, 219-232.

Experiments are described showing that the specific rotations of mixtures of dextrose and levulose in equal proportions in solution are those which the sugars would have if each were present alone at a concentration equal to the total invert sugar concentration.

¹ I.S.J., 1920, 107.

² Cf. BLAIR CLARK and SCALES, I.S.J., 1919, 521; also BRUHNS, *Zettisch. anal. Chem.*, 1920, 9, 337-359, who have elaborated somewhat similar processes.

Review of Current Technical Literature.

RE-TESTING THE CONSTANT FOR HERZFELD'S MODIFICATION OF THE CLERGET DOUBLE POLARIZATION METHOD. *Fr. Herles. Zeitschrift für Zuckerindustrie der czechoslovakischen Republik*, 1921, 45, No. 31, 223-225.

A paper presented to the International Commission for the Unification of Methods of Sugar Analysis in New York in 1912 is reprinted. Solutions of sucrose containing 13.0, 19.5, and 26 grms. in 100 c.c. and in some tests also varying amounts of clarifying reagents were polarized; 50 c.c. of these solutions plus 25 c.c. of water and 5 c.c. of hydrochloric acid (1.188 sp. gr.) were transferred to a 100 c.c. flask, hydrolysed as usual, made up to the mark, and polarized at 20°C., the following being the average values of the constant thus obtained:—

DIRECT POLARIZATION OF THE SUCROSE SOLUTION.	50°	75°	100°
Pure sucrose solution.....	132.26	.. 132.46	.. 132.66
Ditto, plus 5 c.c. of Herles' (basic lead nitrate) re-agent	132.42	.. 132.60	.. 132.80
Ditto, plus 10 c.c. of Herles' re-agent	132.59	.. 132.75	.. 132.96
Ditto, plus 15 c.c. of Herles' re-agent	132.76	.. 132.94	.. 133.12
Ditto, plus 15 c.c. of Herles' re-agent and 1.5 of carbonated molasses ash	—	.. —	.. 133.50
Ditto, plus 15 c.c. of Herles' re-agent and 2.6 grms of carbonated molasses ash	133.50	.. —	.. 133.86
Ditto, plus 15 c.c. of Herles' re-agent and 2.6 grms of carbonated molasses as neutralized by acetic acid	133.27	.. —	.. 133.63

Additions of various decolorizing agents (presumably to the solutions used for the direct readings) were also made. Ordinary animal charcoal decolorized sufficiently, but it raised the constant to a marked extent. Char which had been extracted with hydrochloric acid is said to have decolorized badly, though it had little influence on the constant. Zinc powder decolorized only when used in large amount, the liquid being heated and the constant raised. Merck's *carbo animalis puriss pro analysi* decolorized very strongly, 0.3 grms. per 100 c.c. being sufficient, but this amount lowered the constant by 0.13. A formula was constructed for the calculation of the constant at 20°C., this being: $131.86 + (0.008 P + 0.033 H + 0.075 nM)$, P being the direct reading, H the c.c. of Herles' re-agent added, M the ash per cent. in the product examined, and n the multiple or fraction of the normal weight per 100 c.c. serving for the direct reading, 50 c.c. of this solution being hydrolysed with the addition of 25 c.c. of water and 5 c.c. of acid (1.188 sp. gr.) in the accepted manner.¹

CUPROUS OXIDES OBTAINED ON REDUCING ALKALINE CUPRIC SOLUTIONS (AS FEHLING'S LIQUOR). *V. V. Sarma. Chemical News*, 1921, 122, No. 3177, 99-100.

Reference to previous literature shows that the best method for preparing yellow cuprous oxide is by reducing a cupric salt in the presence of alkali by means of hydroxylamine.² It has also been stated that in the case of Fehling's solution the character of the precipitated cuprous oxide depends upon the proportion of alkaline tartrate solution added, a red precipitate forming when much is present, and the yellow body when the amount is small.³ It has been observed by the writer that if the alkali be first added to a cupric salt, then the glucose solution, and if the reduction be effected at room temperature (25-30°C.), the colour of the precipitated oxide will range from orange to brick-red; ⁴ but

¹ HERLES, therefore, confirmed Herzfeld's results, obtaining in the cases of the three concentrations almost identical factors. However, Herzfeld's values have lately been found by JACKSON and GILLIS (*I.S.J.*, 1920, 514), and by SCHREFFEL (*Ibid.*, 1921, 225) to be too low.—ED. *I.S.J.*

² L. MOSER, *Zeitsch. anorg. Chem.*, 1919, 108, 112-120.

³ *Ibid.*

⁴ FISCHER and HOOKER recently attributed these various colours to the formation of colloidal cuprous oxide of varying degree of dispersion, but their paper (*I.S.J.*, 1919, 76) does not seem to have been read by the author of the present contribution.—ED. *I.S.J.*

if the reduction takes place in hot solution, a brick-red precipitate forms at once. If, however, the glucose solution be first added to the cupric salt, and the alkali be added lastly, a rich yellow precipitate with no tinge of red is produced in a short time. Once formed, it is very stable; and the solution may be heated to boiling and the dried precipitate heated at 150°C. without loss of colour. Analysis showed that this yellow precipitate is not pure cuprous oxide, but seems to contain an appreciable amount of cuprous hydroxide.

EXPERIMENTS ON BEET CULTIVATION IN CANADA. (1) *Report of the Division of Chemistry for the year ending March 31st, 1916; Department of Agriculture, Dominion of Canada, 108-115.* (2) *Report of the Dominion Experimental Farms for the year ending March 31st, 1919, 52-53.* (3) *Monthly Bulletin of Agricultural Statistics, October, 1920; Canadian Bureau of Statistics, 295-301.*

During some years past the Division of Chemistry of the Experimental Farm Branch has carried on an investigation to ascertain the suitability of soil and climatic conditions in various parts of the Dominion in respect to sugar beet cultivation. Some of the results obtained are summarized in these three papers. (1) Vilmorin's improved A, Vilmorin's improved B, and KLEIN WANZLER varieties were grown during the 1915 season, and in the case of the last named, the figures obtained varied as follows: Sucrose in juice, per cent., 10.0 to 21.1; purity, 70.2 to 98.5; yield per acre, 4 tons 1438 lbs. to 19 tons 700 lbs. (2) In these tests carried out during 1918, in addition to the varieties previously stated, Italian, Russian, and Canadian grown seeds were used, the sugar in the juice varying from 15.99 to 17.02 per cent. and the purity from 80.45 to 84.19. No yields were stated. (3) An attempt is made in this article by Mr. E. G. McDougall, of the Dominion Meteorological Service, to correlate the experimental results obtained during the past few years with the weather factors. It was concluded that: (a) conditions are favourable when the mean temperature exceeds 60°F. (15.5°C.) and the relative humidity is greater than 80 per cent., but unfavourable when the temperature falls below 55°F. (13°C.) and the humidity is below 70 per cent. (b) the yield is little affected by variations in rainfall, provided the crop is thoroughly cultivated; (c) the quality of the beets depends chiefly on the night temperatures, it being observed that the sugar content and purity decline when the mean temperature for the season falls below 45°F. (7.5°C.); and (d) the best yields are obtained in the warmer parts of Ontario, and the highest sucrose content and purity in British Columbia, Southern Alberta, and the Maritime Provinces.

VOLUMETRIC DETERMINATION OF LACTOSE BY THE ALKALINE PERMANGANATE METHOD.

F. T. Adriano. *Philippine Journal of Science*, 1920, 17, 213-220

A modification of the method recently described by QUISUMBING¹ is applied to the determination of lactose in milk, the results obtained being found to be concordant, but slightly lower than those obtained by the Soxhlet method.

QUESTION OF THE UTILIZATION OF THE AMMONIA EVOLVED DURING BEET SUGAR MANUFACTURE. Karl Andriik and Vlad. Skola. *Zeitschrift für Zuckerindustrie der czechoslovakischen Republik*, 1921, 45, 179-182, 187-190, 195-198.

A rather thorough examination of the amount of ammonia actually liberated at the different stations of the beet sugar factory has now been made, thus supplementing the work done by others on this subject.² Laboratory experiments showed the amount evolved during carbonatation to be inappreciable, this confirming Rueff's theoretical considerations³; while factory tests gave the following figures for the amount of (a) total nitrogen and (b) ammonia-combined nitrogen in the diffusion juice, 0.077; 0.0035; and after the second carbonatation and before boiling, 0.066, 0.0043 per cent respectively. This decrease of the total nitrogen is caused, firstly by the removal of a certain amount in the scums, and secondly by its volatilization as ammonia; while the increase in the amount of ammonia

² *I.S.J.*, 1921, 107.

³ *I.S.J.* 1920, 281.

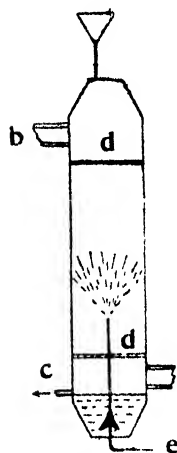
³ *Zeitsch. Zuckerind. czechoslovak.*, 1919-20, 239 and 377.

Review of Current Technical Literature.

after carbonatation is due of course to the further degradation of protein substance. Actual determinations of the ammonia (NH_3) evolved per 100 of roots showed 0.0019 during carbonatation and 0.0058 during heating; while in the evaporator condensed waters 0.0074 per cent. was collected, a total amount of only 0.0151 per cent. Thus by far the greatest proportion (49.0 per cent.) is evolved during evaporation, and a ready process for separating the ammonia from these waters is required, since distillation yields the small amount present only slowly. A cheaper and simpler process should be devised.

RECOVERY OF THE AMMONIA EVOLVED DURING CLARIFICATION AND EVAPORATION IN THE BEET SUGAR FACTORY. A. Dahle. *Die deutsche Zuckerindustrie*, 1921, 46, No. 15, 209-210.

Almost concurrently with the experiments carried out by ŠTERBA¹ and SILHAVÝ and HRUDA² in Czecho-slovakia, tests have been made by Dr. C. RUHNKE in Blankenburg, Germany, and his work was later taken up by the author. It is considered that in consequence of their "colossal price," phosphoric and sulphuric acids are out of the question for absorbing the ammonia from the vapours in which it is present; but hydrochloric acid is recommended, the ammonium chloride thus produced (which when pure contains 26.1 per cent. of nitrogen) being said to be as suitable as a manure as the sulphate salt. In the illustration is shown a sketch of the type of apparatus constructed of w.i. which was used. Its length was about 7 m. (23 ft.) and its diam. about 1 m. (3.3 ft.), the tube *a* being connected with the ammonia or incondensable gas pipe of the evaporators, while *b* leads to a fan for rapidly drawing the gases out of the effect into the absorber. Dilute hydrochloric acid is forced into the apparatus by means of a small "Mammut" pump and "atomized" by sending it through a suitable jet. At *d*, *d*, are shown wooden shelves, which are perforated; and at *c*, the run-off pipe, which continuously carries the ammonium chloride solution to a vessel for concentration and crystallization. One man is sufficient for looking after this recovery apparatus. It is said that it is possible to obtain about 42 kg. of crude ammonium chloride daily in the working of about 12,000 centners of roots, the product obtained in the experiments made, being found by the Institut für Zuckerindustrie to contain 13.4 of nitrogen, and also iron and other impurities, which latter of course could be obviated in a plant constructed of suitable non-corroding material.



TWENTY YEARS AVERAGE ANALYSES OF CUBAN RAW SUGARS, AND THEIR QUALITY FROM THE POINT OF VIEW OF THE REFINER. W. D. Horne. *Facts about Sugar*, 1921, 12, No. 7, 130-131.

In the following table are shown the average analyses of Cuban sugars received at one of the U.S. Atlantic coast refineries:

Period.	Pol'n.	Glucose.	Water.	Ash.	Organic Matter.	Permissible Water.
1901-1910 ..	94.81 ..	1.41 ..	1.42 ..	0.60 ..	1.77 ..	1.66 ..
1911-1919 ..	95.64 ..	1.29 ..	1.16 ..	0.60 ..	1.31 ..	1.31 ..
1920 ..	95.76 ..	1.22 ..	1.68 ..	0.59 ..	1.32 ..	1.27 ..

A study of these figures (and more particularly of the yearly analyses) shows that the variations, though comparatively slight, have on the whole been in the right direction. Thus the polarization has risen gradually, and the moisture decreased, while the ash has remained about constant. "It would hardly seem consistent with the best factory practice that the glucose should have fallen from 1.29 in the last nine years to 1.22 in 1920 without the organic matter also showing some appreciable loss. The fact that this constituent has

¹ *I.S.J.*, 1920, 231.

² *Ibid.*, 1921, 292.

risen from 1.31 to 1.32, although the polarization has gone up and the ash has gone down a little, indicates pretty clearly a slight increase of organic matter at the expense of the glucose. This tendency should be guarded against, as its detrimental results in practice have been very clearly indicated in certain exaggerated cases during the past year. Raw sugars whose glucose has been partly converted into organic impurities by overliming or overheating or both have proven very troublesome to refiners. . . ."

LEAF TYPE FILTERS COMPARED WITH PLATE-AND-FRAME PRESSES. *L. W. Thurlow. Sugar News, 1920, 1, No. 15, 21-26.*

In the central in the Philippines in which these tests were carried out, there were originally three plate-and-frame presses, each of 240 sq. ft., a sufficient area for the juice from 140 tons (metric) of cane per day; but later the capacity of the mill was increased to 250 tons of cane, and a leaf type filter was installed, the opportunity during nearly two months for a comparison between the two apparatus thus being given. It was noticed at the outset that the time taken in filling the leaf filter is practically unremunerative, and that therefore the capacity of the apparatus depends a good deal on the size of the pump used. In the case of the leaf filter, the average Brix of the wash water was 13.19; the purity of the wash water 82.5; amount of wash water at the end of the operation, 81.7 per cent.; the sucrose in the mud cake, 0.82 per cent.; the sucrose in the wash water, 10.78 per cent.; and the wash water used, 777 litres. Under better operating conditions, the amount of wash water could have been reduced, and the sucrose content of the cake lowered to 0.5 per cent. It was noted that the difference between the purity of the filtered juice and that of the wash water is only 1.8, and that the purity of the last sample of wash water was only 2.6 less than that of the original filtered juice. This difference is in great contrast to that observed in the case of the last washings from the plate-and-frame presses, which frequently drops to 50. It was further observed that the difference in purity between the clarified and filtered juices is always considerable (about 3.8) when ordinary filter presses are used; whereas with the leaf filter it was small (only about 0.5). This is an important point, since the amount of filtered juice averages 10-20 per cent. of the mixed juice, making the loss of sugar per 1000 tons of cane crushed equivalent to about 1 ton of 96.5° test per day with the plate-and-frame, but much less with the leaf filter. Other points in favour of the newer type are that loss of sucrose by bacterial decomposition is much less; there is no breakage of plates; one set of cloths will last practically the entire season; a foreman and three labourers would be quite sufficient to handle the press and mud tank stations of a 1000-ton plant; everything is done by machinery, excepting the actual sluicing of the mud from the leaves; opening, closing, and cleaning can be done in about one-third of the time required for filter-presses; and lastly the capacity for equal filtering areas is about double.

SYSTEM OF BOILING AT BALS, ORIENTAL NEGROS, P. I. *E. C. Zitkowski. Sugar News, 1921, 2, No. 2, 55-56.*

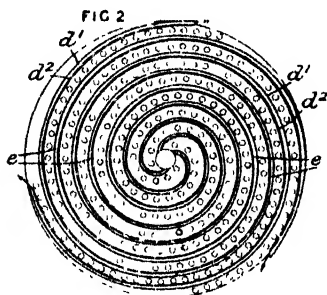
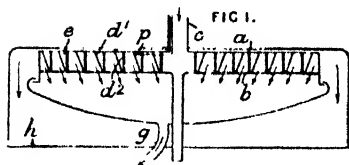
A system claimed to be productive of the best results in the shortest possible time is described. Syrup is drawn into No. 1 pan, where it is grained, and cut to No. 3 pan. After refilling No. 1 pan with the syrup, it is cut to No. 2 pan. Pans 1 and 2 are built up on syrup and first molasses, to give the desired purity; and No. 3 is finished with first molasses, no more syrup being added to the cut. Thus, two strikes of first sugar and one of second are obtained from a single graining. After drying the B-massequite in the centrifugals, the sugar is mixed with sufficient first molasses, and pumped into the crystallizer containing No. 1 massequite, with which it is mixed and dried together, producing a 96.5° sugar. As advantages of this system, it is mentioned that all the graining is done with syrup, and can be effected more rapidly than with molasses; no sugar is returned to the pans, as when using low-grade "seed"; and only syrup and first molasses are carried on the pan floor.

CAUSES AND PREVENTION OF SUGAR DUST EXPLOSIONS. *Gotthardt Liebetanz. Deutsche Zuckerindustrie, 1921, 46, 19-20, and 38.*

Review of Recent Patents.¹

UNITED KINGDOM.

CENTRIFUGAL MACHINE FOR CONTINUOUSLY CLARIFYING LIQUIDS *A. J. M. Rialland*, of Versailles, France. 157,974 (1746). January 11th, 1921; convention date, April 30th, 1919; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.



A centrifugal separator for continuously clarifying liquids has two rotating surfaces *a*, *b* with a number of spiral passages *e* between them extending from the axis to the periphery and being open at each end. The wall *d*² of each passage is perforated, and liquid is supplied through the centre pipe *c* and the separator is rotated. The liquid passes through the perforated walls *d*² and strikes the inclined unperforated walls *d*¹; it is thus deflected through the lower plate *b* and passes out by the pipe *g*. Any solid particles remain in the passages until they reach the periphery and then pass into the container *h*. A pipe *p* may introduce a liquid in the form of a jet or spray into the passages. In a modification the matter may travel from the circumference to the centre and the container may rotate with the liquid while the separator remains stationary. In another modification the rotating surfaces may be conical; and in another modification the passages, instead of being spiral, may be straight and may project tangentially from a central tubular shaft.

LIQUID FUEL CONTAINING COAL ("COLLOIDAL FUEL"). *J. J. V. Armstrong*, of Rock Ferry, Cheshire, assignee of *H. Plauson*. 155,212 (84,843). December 10th, 1920.

A fuel comprises 35-70 parts of finely pulverized coal, coke, or other carbonaceous matter stabilized in 65-30 parts of oil or other liquid hydrocarbon by treating the mixture for 1-2 hours in cross-pounding or other mills having a speed of at least 1000 metres per second. The process is accelerated by adding 1-3 per cent. of soap solution or rubber solution or other colloid to the mixture.²

COLLOIDAL PHOSPHATIC MANURE. *H. Plauson and J. A. Vielle*, of London. 156,124 (36,465). December 30th, 1920; convention date, November 5th, 1919; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Phosphates are rendered assimilable for the purpose of utilization as a manure by grinding them with a large quantity of water, to which has preferably been added a small amount of acid or alkali. In this way, the finely divided phosphate becomes hydrated and assumes a colloid-like form, which after drying is equal in value to water-soluble phosphate. The transformation is accelerated considerably by the addition of only 0.1-0.3 per cent. of sulphuric, nitric, or phosphoric acid; and also by conducting it under pressure or by heating to about 90-95°C., or again by adding protective colloids, as the alkali salts of humic acid.

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

² See also *I.S.J.*, 1921, 131; and U.K. Patent, 156,138.

PRESS FOR MOULDING PASTILLES, ETC. *E. Gaillard*, of Territet, Switzerland. 155,594 (35,722). December 20th, 1920; convention date, June 11th, 1919; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

PRESERVATION BY STERILIZATION OF BEEF SLICES, ETC. *T. Schweizer*, of Dresden, Germany. 156,173 (36,671). December 31st, 1920; convention date, October 20th, 1919; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Green vegetables and other vegetable substances such as remains of fruit, slices of sugar beet, distillers' wash, etc., are stored in vessels through which an electric current can be passed to sterilize the materials, which may be previously treated to improve the conductivity.

MOTOR SPIRIT CONTAINING ALCOHOL *Farbwerke vorm. Meister, Lucius, & Bruning*, of Hoechst-on-Main, Germany. 157,222 (1096). January 8th, 1921; convention date, March 24th, 1915; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Hexahydrobenzene, alone or with a little alcohol, benzene, or other hydrocarbon, is used as a motor spirit.

CENTRIFUGALS. (1) *Maskin Aktiebolaget Kosmos*, of Stockholm. 157,334-157,336 (1246-1248). January 10th, 1921; convention date, March 30th, 1914; *not yet accepted*; abridged as open to inspection under Section 91 of the Act. (2) *P. T. Sharples*, of St. Davids, Penn., U.S.A. 157,688 (16,867). June 22nd, 1920. (3) *H. A. Gill* (*Sharples Speciality Co.*, of West Chester, Penn., U.S.A.). 160,112 (18,906). July 6th, 1920. (4) *G. H. Elmore*, of Swarthmore, Penn., U.S.A. 158,152 (3894). February 9th, 1920.

PREPARATION OF DECOLORIZING CARBON FROM CARBONACEOUS RESIDUES (AS IN SHALE DISTILLATION), AND ITS REVIVIFICATION. *Catlin Shale Products Co.*, of Manhattan, New York, U.S.A. (assignees of *R. M. Catlin*, of Franklin Furnace, New Jersey.) 157,393 (1314). January 10th, 1921; convention date, April 25th, 1916; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

A silico-carbonaceous material for decolorizing sugar solutions and other liquids is obtained by the limited treatment with hydrofluoric acid of carbonaceous residue of a technical carbonizing process, for example, shale distillation, the raw material being finely ground, and is treated with diluted acid preferably of 16 per cent. strength. The properties and yield of the product depend on the proportion and strength of the acid, and the duration of the treatment depends on the strength of the acid, and whether or not the materials are agitated. When, after repeated use, the material loses its decolorizing properties, they may be recovered by heating the material without access of air, or by treating it with hydrofluoric acid, and washing and filtering as before; and this method of revivification is also applicable to other decolorizing materials such as bone-black and other carbons.

CONFECTIONERY MOULDING MACHINERY. *R. Letang and R. Rouart*, of Paris. 157,775 (1483). January 10th, 1921; convention date, December 2nd, 1913; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

CONTINUOUS INDICATION OF THE SPECIFIC GRAVITY OF A FLOWING LIQUID. *S. D. Wells and R. J. Marx*. 158,151 (1929). January 21st, 1920.

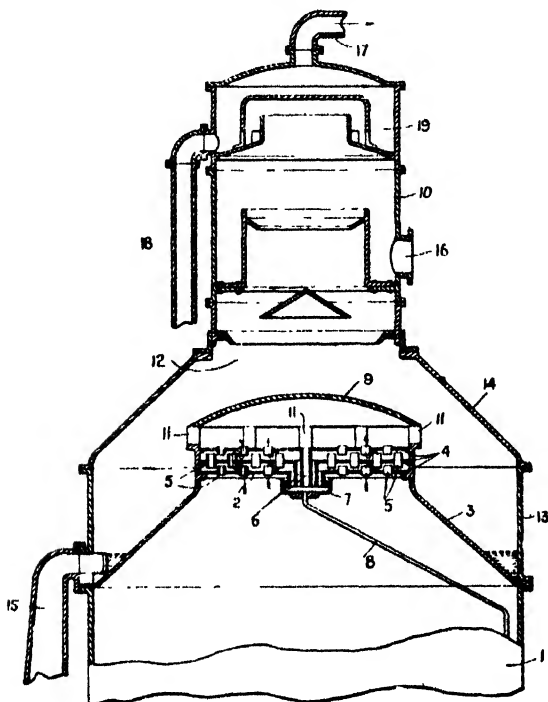
Relates to apparatus for continuously indicating and recording the sp. gr. of a flowing liquid of the type in which the liquid flows through a balanced container system of constant volume.

Patents.

UNITED STATES.

RECTIFIER (ENTRAINMENT SEPARATOR) AND CONDENSER FOR EVAPORATORS AND VACUUM PANS. *Herman E. Beyer and William G. Hall*, of Honolulu, Oahu, T. H. 1,352,648. September 14th, 1920. (One drawing.)

Referring to the figure, it is seen that the rectifier 2 comprises a plurality of plates 4 having short lengths of piping 5 inserted in each, the pipes 5 in each plate 4 being staggered in relation to those in the adjoining plates. This is for the purpose of providing a tortuous passage for the vapours arising from the vacuum pan and for the purpose of



preventing particles of fluid from being carried off into the condenser with the vapour. Each of the plates 4 of the rectifier 2 is provided with a central orifice or hole 6 terminating below the edge of a liquid sealing cup 7, and from the central portion of the liquid sealing cup 7 extends a small pipe 8 to drain liquid back into the bottom of the vacuum pan. Directly above the rectifier 2 is a crown sheet 9, which acts as a baffle for the falling cascade of water from the condenser 10 above. This is spaced from the rectifier 2 by means of short struts 11 so that there is a large area of opening for the vapours to pass from the rectifier 2 into the lower portion 12 of the condenser. This condenser 10 is itself mounted upon the upper surface of the cone 14 and comprises a countercurrent apparatus of the form protected by one of the

inventors,¹ so that a further description is not necessary. The circulating water is admitted through orifice 16 and the air pump is in communication with the pipe 17 extending from the top of the condenser to remove any air that may be contained in the solutions. A pipe 18 communicates with the baffle chamber 19 to drain any water which may be carried over into this chamber.

From the above description it will be seen that the velocity of the vapours arising from the evaporating pan is not increased to any perceptible degree and is therefore very low. From the rectifier 2 the vapours come directly in contact with the circulating or cooling waters of the condenser without passing through any additional piping or having their velocity increased by passage through piping of reduced diameter, so that there is neither heat nor fluid lost in the piping.

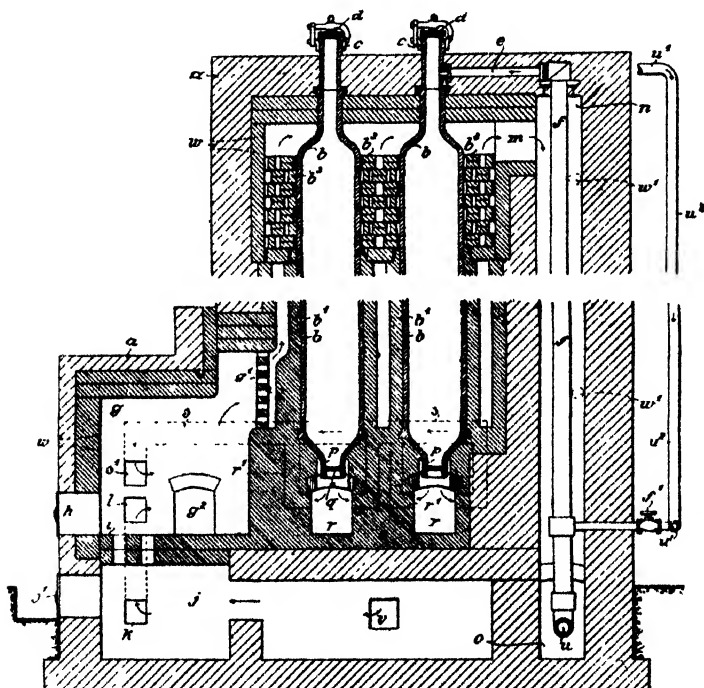
PROCESS OF MAKING SOLUBLE CHOCOLATE. *Jacob Friedman*. 1,364,192. April 2nd, 1919; January 4th, 1921.

A soluble preparation capable of being moulded and of withstanding a relatively high temperature without softening is produced by boiling syrup, adding a liquid extract, cooling, powdering the solidified mass, and mixing it with powdered cacao beans and fat.

¹ U.S. Patent, 1,162,969, granted to HERMAN E. BEYER.

DECOLORIZING CARBON MANUFACTURE, USING SUPERHEATED STEAM. *Raphael von Ostrejko*, of Krakow, Austria, (assignor to the *Chemical Foundation, Inc.*, of Delaware, U S.A.). 1,362,064. December 14th, 1920.

The lids *d* of the retorts *b* being removed, the retorts are charged from above with charcoal in a comminuted state. After that, the lids are hermetically closed and a fire is started on the grate *i*, all the slides and steam valves being closed. The flue-gases pass from the furnace through the openings in the pierced fireproof wall *g'*, into the space between the fireproof jackets *b'* of the retorts *b*, which are held apart by fireproof bricks *b²*. The result of this arrangement is that owing to the open-work wall *g'* and the bricks *b²*, the flue-gases distribute themselves uniformly and take an extremely sinuous path through the inner space of the oven, being in this way completely utilized. The interior of the oven communicates by means of an exhaust flue *m* with the space *n*, in which superheated pipes *f* are disposed, so that they must necessarily pass through the space *n* in order to reach the flue *o* of the chimney. As soon as the retorts have been heated up to a red heat (a fact which may be determined by peeping through the openings *w*), superheated steam is admitted into the retorts by opening the valves *f'*. The steam acts chemically on the charcoal and liberates combustible gases which pass through the openings *p* and the holes in the side plates *q* into the conduits *r* underneath the retorts *r*, *r'*, and *s*, *s'*, where they are finally burned.



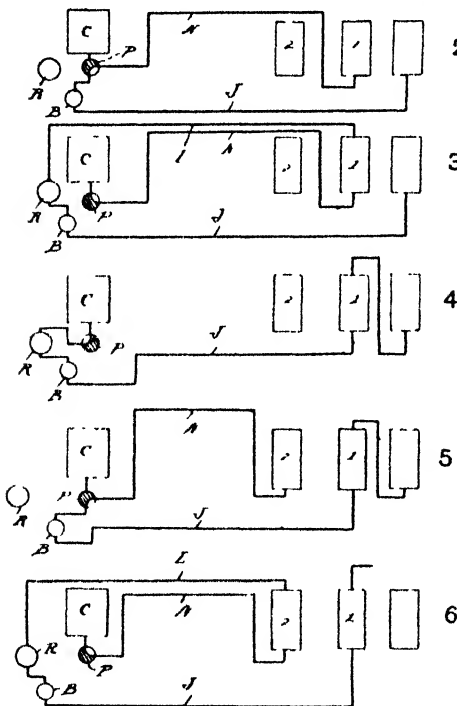
When the front end of the oven has become white hot, the amount of steam supplied to the retorts is increased, and, at the same time, the fire-door *k* and the door *j'* of the ash-pit *j*, are hermetically closed. In consequence of this arrangement, the admission of air to the furnace is possible only by way of the adjustable opening *v* and the conduits *k*, *l*, adjustable by means of the slides *k'*. The subsequent heating of the plant is effected without the addition of fresh supplies of fuel, and in such a manner that the combustible gases formed by the action of the steam on the charcoal in the retorts, which pass into the furnace through the conduits *r*, *r'*, and *s*, *s'*, are burned in the furnace in the presence of air admitted through the openings *v*, *k*, and *l*. The waste gases serve to heat the furnace

Patents.

and the retorts; so that, speaking in a certain manner, the entire operation is carried through in a cycle. As soon as a portion of the decolorizing charcoal is ready, a certain quantity thereof is discharged into suitable vessels arranged in the conduits *r*, by opening the perforated slides *q* which are provided with operating-rods *q'*, after which the charcoal thus withdrawn is conveyed through the openings *s*². In order to still further improve the charcoal, it is conveyed through the side openings *g*², which are adapted to be closed, to the rear portion of the furnace *g*, which is heated to a white heat. The admission of air from the atmosphere into the furnace is entirely excluded for a time, by closing the slide *k* and the door *v*.

PROCESS OF EXTRACTING SUGAR BY DIFFUSION. *Léon Naudet*, of Chelles, France.
1,343,737. June 15th, 1920 (original application filed March 5th, 1914; divided; and this application filed May 24th, 1916). (Six figures.)

It is the main feature of this process to raise the temperature of the vegetable material (beet or cane) in the newly installed cell to the maximum, so as to effect a higher extraction and induce sterilization. According to the ordinary mode of working, two operations are performed: (1) mashing, the juice being introduced through the bottom of the cell; and (2) displacing the mashing juice, by an equal volume of juice being introduced through the bottom of the cell. Thus, the freshly introduced beet or cane comes into contact with *twice* its weight of juice before another cell is added to the series; but this is not a sufficient



amount to raise the temperature of the beet or cane to that of the juice. Three times its weight is the amount required. According to the present specification, this may be accomplished by a single heating of a single pass of juice in each cell, as shown in Figs. 2 to 6.

In Fig. 2, cell number 1 contains fresh beet or cane, which is mashed by juice entering the bottom of the cell, the juice being at less than maximum temperature. In Fig. 3, the mashing juice in cell 1 is displaced by juice entering the top of the cell which has been passed through the heater *R* and raised to maximum temperature, such as 100° C. or over, the mashing juice being displaced into the measuring tank *C*. In Fig. 5, the first-pass maximum temperature juice in cell 1 is displaced by a second pass of juice from the preceding cell, which may be assumed to be at the same maximum temperature of 100° or over. The displaced first-pass juice enters cell 2, which has just been installed with fresh beet or cane and is used for mashing this material. In Fig. 6, a third

pass of juice from the preceding cell and at the same maximum temperature is passed through cell 1 to displace the second-pass juice therein, and this displaced second-pass juice is passed through heater *R* and enters cell 2 to form first-pass juice for this cell and to displace the mashing juice therefrom into the measuring tank *C*. After this third-pass the material in cell 1 will have acquired the full temperature of 100° C., and consequently any further passes of juice through this

cell will not be lowered in temperature by the material therein. Thus, a fourth pass of juice through the cell 1, which will displace third-pass juice therefrom to form the second pass for cell 2, will enter said cell at the maximum temperature of 100°C., and a fifth pass through cell 1, displacing juice to form a third pass through cell 2, will also enter the latter cell at the maximum temperature of 100°. In this manner there are three passes of juice at maximum temperature through cell 2, and in like manner there will be three maximum temperature passes through each succeeding cell of the series.

In practice it may be desirable to use more than an equal weight of juice, and to make allowance for this extra volume there is an intermediate stop, illustrated in Fig. 4. As may be seen, the surplus volume of juice passes through cell 1 without first being re-heated, then through the heater *R* directly into the measuring tank *C* instead of passing through the heater *R* before entering cell 1.

PREPARATION CONTAINING SUGAR AND FRUIT. *Nathaniel C. Fowler*. 1,374,160. April 5th, 1921.

It consists mainly of sugar in a finely divided state with which is combined a product derived from the pure grinding of partially dried fruits.

FILTER FRAME FOR USE WITH PRESSURE FILTERS. *Louis J. Martel*, (Assignor to *Martel Filter Co., Inc.*, New Orleans, La., U.S.A.) 1,370,470. March 11th, 1920; March 1st, 1921.

HEAD MECHANISM FOR FILTER-PRESSES (OF THE LEAF TYPE). *Jasper A. McCaskell*, (Assignor to *Kelly Filter Press Co.*). 1,371,634. April 25th, 1917; March 15th, 1921.

CHOCOLATE DEVELOPING MACHINERY. *Oscar M. Stout*, of Brooklyn, U.S.A. 1,349,235. May 22nd, 1919; August 10th, 1920.

EVAPORATOR LEVEL CONTROL.¹ *Wm. H. Ripley* (Assignor to the *Griscom-Russell Co.*), U.S.A. 1,361,905. May 17th, 1917; December 14th, 1920.

MAKING SOLUBLE CHOCOLATE. *Jacob Friedman*, of New York, U.S.A. 1,364,192. April 2nd, 1919; January 4th, 1921.

Claim is made for a process consisting in boiling syrup, mixing a liquid extract therewith, allowing the mass to cool and set, pulverizing the mass, and mixing the pulverized product with ground cocoa bean and fat in proportion to produce a soluble chocolate mass which may be moulded. This mass is said to withstand a relatively high temperature without softening.

GERMANY.

PRODUCTION OF HIGHLY ACTIVE VEGETABLE DECOLORIZING CARBON IN GRANULAR FORM. *Verein Chemischer Fabriken*, Mannheim, Germany. 309,221. April 15th, 1917.

Active carbons for decolorizing, deodorizing, or gas absorption may be prepared from vegetable substances by a series of processes, such as: (1) a precipitate of magnesium carbonate is produced in the pores of the material, which is subsequently heated to a high temperature; (2) a bituminous mass is treated first with an alkali and afterwards with an acid, or conversely, and heated for about an hour after the expulsion of the gases formed; (3) cellulose substances are heated first at a low temperature, about 200-300°C., and then to a higher one, 600-700°C. without the addition of any impregnating agent; (4) peat is impregnated with different alkaline chemicals, potash for example, and heated to 600-800°C.; and (5) vegetable substances are impregnated with readily soluble salts, as calcium chloride, and carbonized only at low temperature. According to this specification,

¹ U.K. Patent, 146,730; *I.S.J.*, 1920, 711.

Patents.

products made by such processes have as a disadvantage, either that their power is only moderate, or else that a very fine powder results, making filtration difficult. A very active carbon, capable of being readily removed in filtration, is claimed to be made by the following method of working. Vegetable matter, wood for example in pieces 3-5 mm. diam., is heated without any previous treatment to a moderate temperature, say 400-500°C., its form remaining unaltered for the greater part. It is then soaked with a solution of potassium hydroxide or carbonate, and the temperature raised to a bright red heat, i.e., 1000-1100°C. This product, which still retains almost entirely the structure of the raw material, is finally thoroughly washed with water, and dried. A still stronger carbon is produced by preliminarily treating the raw material with an electrolyte. Thus, comminuted wood is soaked in concentrated calcium chloride solution; heated to 400°C.; washed; treated with potassium hydroxide or carbonate solution; heated to 1000-1100°C., and finally washed again, when a carbon of "extraordinarily high activity" is obtained, still largely retaining the form of the raw material.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

- EVAPORATORS. (1) *B. Junquera*. 144,240 (19,639). May 30th, 1919. (2) *A. Rambaud*. 144,631 (15,019). June 10th, 1919. (3) *G. Bonsigori*. 162,877 (7408). March 12th, 1920.
- FILTERS. (1) *W. J. Still*. 161,639 (325). January 5th, 1920. (2) *J. Miller and Geo. Fletcher & Co., Ltd.* 161,993 (11,142). May 5th, 1919.
- APPARATUS FOR GRAPE HONEY AND FRUIT SYRUPS MFG. *Barbet et Fils et Cie* 153,548 (1972). Addition to 135,175. October 31st, 1919.
- MILLS. (1) *C. McNeil*. 161,726 (2358). January 26th, 1920. (2) *E. D. Simon and H. Simon, Ltd.* 161,739 (2803). January 29th, 1920. (3) *F. J. de Bruin*. 162,533 (10,931). April 20th, 1920.
- CANE CRUSHING APPARATUS. *L. W. Gould (Fulton Iron Works Co.)*. 162,975 (21,433). July 16th, 1920.
- SCRAPERS FOR CANE MILLS. *W. Mackie*. 162,124 (4317). February 12th, 1920.
- SACCHARIFICATION OF CELLULOSE. (1) *A. Wohl*. 146,860 (18,744). April 7th, 1917. (2) *A. Classen* 142,480 (11,691). March 18th, 1919.
- MANUFACTURE OF LACTOSE OR MILK SUGAR. *J. Tavoroges, J. W. Roche, and G. Martin*. 161,887 (22,019). July 22nd, 1920.
- SULPHUROUS ACID MANUFACTURE. *Rhenania Verein Chemischer Fabriken A.-G.* 161,581 (10,489). April 14th, 1920.
- CONFECTIONERY MANUFACTURE. *W. V. Dawkins*. 161,740 (2967). January 30th, 1920.
- DECOLORIZING CARBON MANUFACTURING. (1) *C. S. Hudson*. 139,156 (1846). February 15th, 1919. (2) *C. Revis and de Bruyn, Ltd.* 162,117 (3698). Feb. 6th, 1920.
- SPECIFIC GRAVITY TESTER. *J. H. Kessler*. 162,240 (32,622). November 18th, 1920.
- PURIFYING SUGAR JUICES BY FILTRATION AND DECANATION. *F. Tiemann*. 161,987 (11,561). April 12th, 1920.
- SEPARATING SUSPENDED MATTER FROM LIQUIDS. *A. F. Meston*. 162,390 (2703). January 28th, 1920.
- TUBE SCRAPERS. *Fawcett, Preston & Co., Ltd. (H. W. Taylor)*. 162,525 (10,479). April 15th, 1920.
- CENTRIFUGALS. *P. T. Sharples*. 148,753 (18,472). July 30th, 1919.
- CENTRIFUGAL DRIVE. *W. Hunt, (S. S. Hepworth Co., and E. M. Mackintosh)*. 162,920 (12,599). May 6th, 1920.
- FOOD COMPOSITION. *S. M. Wood*. 140,462; 140,463 (8229; 8230). March 19th, 1920.
- PREPARATION OF BEETS FOR "MARMALADE" MFG. *A. Aumann*. 147,713 (19,707). December 13th, 1917.
- PRODUCTION OF ETHERS OF CARBOHYDRATES. *L. Lilienfeld*. 163,017; 163,018 (13,188; 13,287). May 5th, 1920.
- INCRUSTATION PREVENTION IN BOILERS. *A. Pessi*. 163,013 (12,981). May 6th, 1920.

Sugar Market Report.

Our last report was dated 6th May, 1921.

The general trend of the market during the past month has been in a downward direction, but although values of refined in the home market show a substantial shrinkage, there has been a persistent demand from the trade for spot and immediately available lots. British Refined, American Granulated, and Czecho-Slovakian sugars have been in keen competition for this business. Tate's London Granulated at 61s. 6d. and No. 1 Cubes at 63s. 6d. spot, duty paid, show declines of 2s. and 4s. 6d. per cwt. respectively since our last report; Czecho-Slovak superior granulated is quoted at 32s., ASP, etc., Cubes 34s. per cwt. f.o.b. Hamburg. American Granulated has been selling for near arrival at 32s. c.i.f. U.K. ports, but is now being offered at 31s. 9d., whilst June shipment from the States has been done privately as low as 29s. 6d. c.i.f.

Dutch sugars find little attraction in U.K. prices, WSR being held for 33s. 6d. and J 33s. f.o.b. A fair business has been done in W.I. Crystallized descriptions, which are now quoted at 53s. to 55s. spot, duty paid; Syrups, 47s. 6d. to 47s. 9d., according to quality. Refining sugars are lower, Brazil 96° being offered at 19s. and 80° Syrups down to 11s. 6d. Peru 96° 19s. 6d. c.i.f. U.K.

Lack of confidence in the position and the restriction of activities caused by the continuance of the coal strike, are sufficient to account for the neglect of forward deliveries, and holders find themselves pressing supplies on an unwilling market.

The Terminal Cane sugar market has shown a steady decline, and there are still sellers of small quantities willing to anticipate events by underquoting actual values. Latest transactions include December at 15s. in bonded warehouse, less 2½ per cent. discount. The White Sugar terminal contract for London, now in preparation, will probably be introduced in the near future.

Reports to hand from Cuba indicate favourable conditions for harvesting, and latest statistics show 139 centrals still grinding. Total receipts to 28th May are 2,635,000 tons and stock 1,345,000 tons, compared with 2,977,000 tons and 661,762 tons respectively last year.

The U.S. Emergency Tariff Bill, which has now come into effect, may be expected in its operation to foster an increase in the production of Home American sugars, and will raise the cost to the consumer who, however, will doubtless find an offset in the declining tendency of prices. Exports will be unaffected, being subject to the drawback as heretofore. American markets, in spite of intermediate activity, have followed the general course, and business is reported in San Domingos at 3·00 cents prompt and Porto Ricans at 4·63 cents c.i.f. for June shipment.

White Javas for June shipment are nominal, July quoted 22s. c. & f. Calcutta. Early shipments from Java have been sparingly offered owing to the requirements for contracted early shipments and some uncertainty about the sugar coming forward. It is said that about 70,000 tons have been bought for India for May/June shipment, but when this has been supplied, together with the comparatively small quantities sold for other destinations, the task of handling the main crop remains to be faced. The position of Java is complementary to that of Cuba; whilst Java is starting upon what promises to be a large crop, Cuba is building up big stocks week by week, and unfortunately the outlook for both shows no improvement. Only is the perspective narrowed by the progress of time, and movement of the ever accumulating quantities becomes more and more dependent upon that revival of confidence amongst buyers which is so anxiously awaited, but which shows no present sign of coming. Broadly speaking, whatever the future may prove, production would appear for the moment to be overtaking consumption, and we see production gravely concerned to find outlet upon a consumption unwilling and fully alive to the circumstances. How far the question of price may tempt revival remains to be seen, and it must be borne in mind that there are other considerations involved by the general unsettlement of the world, but, given some sign of stability, there is plenty of power in the existing depletion of invisible supplies to provide impetus for reaction.

H. H. HANCOCK & Co.


10 & 11, Mincing Lane,
London, E.C. 3,
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Notes and Comments.

The Prospects of Trade Revival.

The outstanding feature of trade in the United Kingdom this month is the settlement of the coal strike on terms that, it is hoped, may ensure peace for at least 18 months to come. This disastrous dispute lasted three months, and then was only settled because the miners' executive dropped their customary cumbersome methods of procedure and took the reins into their own hands instead of leaving the decision to the ill-informed rank and file. The miners have in the end wisely realized that in respect to their demands for a pooling of the mines—an economic proposal that the Government refused to accept without a constitutional mandate from the country—it was useless to persist; and they confined their concluding negotiations to the question of wages, when they succeeded in securing themselves better terms than were first offered by the owners, though the new offer does involve some wage reduction. Had the dispute been confined to this wages question the strike might never have occurred, or have been but a brief affair. The moral of the whole is that in the present temper of the country "direct action" will never secure changes of a constitutional order.

What it has cost the country will only be gradually known, as the national revenue is totalled up for the current financial year; but it will not be quite so costly as would have been the case in normal times, since owing to the extremely slack state of trade the last few months, there has been far less business to lose than usual. Trade the world over has been stagnant for months past, partly owing to the inability of producers to guarantee prices or delivery, and partly owing to a universal belief that by waiting a bit quotations would come down.

This last view has been apparently taken in the sugar industry amongst others; there has been great scarcity of orders the last few months for renewals and additions to the plant of sugar factories. It is however not the case that the goods are not wanted, but rather that the hope is entertained that prices will come down below recent quotations to the advantage of the sugar factory proprietary. Meantime the factories jog along on existing plant. But a time must come when renewals or extensions can not be delayed further, and orders on a considerable scale are likely to result. The only doubt in one's mind is whether the impending

purchasers are doing themselves the best service by indefinitely delaying the placing of their orders. It may conceivably arise that when the orders do come, they will come simultaneously from everywhere—whereupon the demand will be so great that the supply will not be equal to giving prompt delivery. If demand outruns supply, the result can only be a rise in the prices.

Production at home should now be in a better position to quote a competitive price, though it is not yet clear what the new price of coal is going to be. Much of course depends on that factor; but the coal question is not the only labour settlement that has lately been effected, since a large number of trade unions have consented after negotiations to reductions of wages; the engineers in particular have composed their differences at a lower rate of wages than has hitherto ruled, so machinery manufacturers will now be able to estimate business possibilities with greater precision. Altogether the outlook for trade in this country is distinctly more hopeful than it has been for months past, though it still gives some cause for anxiety.

The Royal Commission's Trading Account.

Some twelve months ago the daily press was commenting on the enormity of the offence of the Royal Commission on the Sugar Supply in having for the time being made a profit of £6,000,000 out of the British sugar consumer. But it was obvious to most observers in the industry that this was only a temporary gain and that it would be wiped out in the final trading year (1920). We were prepared indeed to find the final balance sheet showing a loss but we confess we were not counting on its amounting to so large a sum as £24,500,000. This, however, is the deficit announced by the Commissioners in their Report just presented to Parliament and published last month. Elsewhere we reproduce a large portion of their Report verbatim, especially those parts that deal with their purchases of the sugar, and the influence of the Ministry of Food on the disposal of it, and the retail prices at which it was sold.

It is easy in these days of "anti-waste" propaganda to feel indignation at this huge deficit; but when one comes to analyse the reasons that have led to it, one is constrained to admit that it was not so much any bungling on the part of the Commissioners themselves as the fact that they had no real control over the disposal of the sugar, which was virtually the monopoly of a State department swayed by motives of a politico-economic order. The taxpayer on whom falls the loss must blame chiefly the Government control which, as the Commissioners point out, would not consent to the raising of the price of sugar to the figure which the Commission thought economically desirable. The Commission's recommendations as to prices were either ignored or only given effect to months after they were made. The result was the consumer benefited by getting his sugar at an uneconomic price; this is shown clearly by the Chart we reproduce comparing the retail prices in England with American spot prices for the years concerned; only for the first three months of seven odd years were the American prices lower than the British ones. It amounts to this, then, that as in so many other instances during the war and after, the British Government preferred to accumulate a liability to be discharged by the taxpayer rather than incur the unpopularity of making the actual purchaser pay an economic price for his sugar.

But of course this State interference does not account for the whole loss. The Commission made a rough calculation that if they had been able to regulate the retail prices themselves they would have saved 16 millions. Allowing then for the wiping out of the former profit of six millions, the losses due to trading would appear

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to have amounted during the final two years of operations to some 14 millions sterling. But here we get on to more debatable ground. The critics say that during the spring and summer of 1920 the Royal Commission bought heavily at excessive prices (particularly the Mauritius crop at £90 per ton) and then when the slump came later in the year had to cut their losses heavily in order to readjust prices to the new level. But did any influential section of the world's sugar market really expect that slump? Is it not plain history that the vast majority of sugar buyers and speculators banked on the American consumption rising through the incidence of the Prohibition Laws to an amount that would absorb all the sugar that offered, and then perhaps ask for more. The buyers for the Royal Commission were admittedly not wiser than the rest and rather than risk seeing this country running short of sugar they deemed it advisable to make purchases which unfortunately (owing in part to crop chronology) synchronized with the top period of the market. But we still think there is something for their contention that their purchase of the Mauritius crop had a fair share in knocking the bottom out of the Cuban market two months later.

It is also pertinent to turn to the States and see what happened there where State control had been lifted in December, 1919. The heavy losses incurred there in 1920 by speculators, dealers, and refiners do not suggest that an absence of State control in this country would have saved us from a considerable loss; it would simply have distributed the loss on other shoulders. Instead of the Government (or rather the taxpayers), the refiners at home, the brokers and speculators, and the consumers would have suffered in pocket by the fall in the sugar market. It is idle to suppose that private enterprise in this country could have succeeded where it had failed in the States.

But the effect of the shouldering of this loss by the State is that no private enterprise in the United Kingdom has been appreciably hit by the slump. Certainly not our refineries nor our sugar brokers. They have had a comparatively easy time of it. And the consumer has been let down lightly, for if he did not get as much sugar as he wanted, neither did he pay the proper price, all things considered, for it.

Hence in so far as the loss was caused by State control, it was merely a case of shifting the burden from the consumer to the taxpayer. And in respect to faulty purchases, an error of judgment was committed but committed in such universal company that one is unable to criticize it narrowly. But in such abnormal circumstances as have ruled in the world during the great war and its aftermath neither the free sugar market in the States nor the controlled one in the United Kingdom can claim to have established a case. Both failed; and all that can now be done is to study the respective facts with a view to avoiding any repetition of them at some future date.

The West Indian Tropical Agricultural College.

We understand that progress is being made with regard to the establishment of the West Indian Tropical Agricultural College in Trinidad and that several meetings have recently been held of the committee appointed by the Secretary of State for the Colonies to deal with the matter. This committee has had the advantage of the presence in London of Sir FRANCIS WATTS, K.C.M.G., who came home recently to press the claims of the West Indian interests generally on the Colonial Office.

As our readers are aware, it is desired to make a special feature of sugar work in the curriculum of this College and to give practical instruction in sugar

making as well as in the cultivation of the sugar cane. The promoters of the college have, from the outset, entertained the hope that it may be possible to have in connexion with the college a model sugar factory on a sufficiently large scale to enable really efficient instruction to be given in the art of manufacturing sugar and in the training of sugar technologists. These hopes bid fair to be realized, for a meeting of the leading British manufacturers of sugar machinery to discuss the matter was recently held in the Royal Technical College, Glasgow, at which the chair was taken by Professor STOCKDALE, the Principal. The meeting was well attended and much interest was manifested in the proposal to establish a model factory for teaching purposes in connexion with the sugar school of the new college.

Sir FRANCIS WATTS explained to the meeting the steps which have been taken to establish the college in Trinidad and the need which exists for the model sugar factory for training technologists, chemists, and sugar makers. He pointed out that nowhere in the British Empire is there an institution in which sugar making can be practically taught using sugar cane and cane juice as the basis of the work of instruction. He then invited the interest and co-operation of the leading British makers of sugar machinery and hoped that they would be prepared to contribute model plant for the equipment of the factory in a generous manner.

This invitation was well received and very cordially indeed responded to. The representatives of several firms, who had had opportunities of considering the proposals beforehand proceeded to make definite promises on the spot. The result was that before the meeting had broken up the following machinery units were most generously promised for the school: an 11-roller milling plant, a water-tube boiler, filter-presses and scum tanks, centrifugals and crystallizers, electrical equipment, assistance with the pumping plant, and assistance with the steel structural work of the building; other representatives stated that while they regarded the proposals with favour and would advise their principals to co-operate heartily, they were not then in a position to make definite offers of machinery, for full particulars of the nature of the factory had not previously been placed before them. But as a result doubtless of their representations definite offers were subsequently received for the required vacuum pan and staging and the juice heater. After some general discussion it was agreed that the best way of carrying on the work begun at that gathering would be for the representatives present to consult their principals and to communicate with Mr. C. T. BERTHOE (who had kindly undertaken the secretarial duties connected with the movement) informing him of the parts that they desired to contribute, and for arrangements then to be made by correspondence concerning the requirements of the factory and the parts which the various firms might be prepared to supply.

The Advantages of a British School.

We are glad that such a step is being taken to provide an all-British model factory at this British school. It has been a blot hitherto on British achievement that so far we have never taken adequate steps to provide for our own sons a tropical sugar school where a complete theoretical and practical course in the science of the industry can be obtained. There is, as Sir FRANCIS WATTS pointed out, no institution within the British Empire in which a student can receive academic instruction in the art of sugar making, using the actual sugar cane as the basis of that instruction. At present such scientific education can only be secured by having recourse to foreign institutions, e.g., the well known and excellent sugar

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school of the University of Louisiana at Audubon Park, New Orleans, and the technical institutions in Java. There is of course the Glasgow sugar school which gives a useful course of instruction in sugar technology by means of which the student can obtain a good insight into the general principles; but it is obviously impossible there to give instruction based on the actual working of the cane and its juice, so that the instruction thus given must necessarily stop short of demonstrating experimentally many of the points and difficulties encountered in actual practice. These demonstrations will now be available at the Trinidad College. Moreover, the students there will be given the opportunity denied them at existing tropical schools to familiarize themselves with the handling of British sugar machinery. We must therefore congratulate the promoters on the handsome gift the English and Scotch engineers have so promptly bestowed on the venture.

The Indian Sugar Bureau.

There would seem to be some delay in the publication of the report of the Indian Sugar Committee, which we had hoped would reach us a month or more ago; but this does not in any sense mean that the Government is sitting with folded hands awaiting its appearance. There are abundant evidences that work is being steadily pursued in the directions laid down by the Board of Agriculture at its 1917 meeting in Poona, and it is with special interest that we have perused the first *Annual Report of the Sugar Bureau*, instituted on the recommendation of that meeting. From this it will be seen that, in spite of the many unexpected calls upon his time, Mr. WYNNE SAYER, the so-called Secretary of the Bureau, but in reality the chief official as far as we can judge, has been able to do a great deal of preliminary spade work. The scattered masses of information regarding Indian sugar questions, which had accumulated in the office of the Reporter of Economic Products, the various Provincial Secretariats, and the office of the Cane-breeding Expert, have been examined and brought together, registered, and made available for reference and for possible future collation and perhaps publication. A promising commencement has been made with the library of the Bureau, and a system of exchanges has been inaugurated with foreign countries. The Bureau is in close liaison with all the factories in the country, as well as the various Government stations where sugar cane is being studied, and this is not only the case with India, but relations have been entered into with all sugar cane growing countries, and the Secretary is in touch with the principal sugar machinery manufacturers in Great Britain and the United States. Lastly, taking advantage of his seat on the Sugar Committee, Mr. SAYER has visited Java, studied the methods of cultivation there, and brought over some of the seedlings recently obtained, which appear likely to be of use in North India. These latter have been relegated to the cane-breeding station for study and multiplication. We congratulate Mr. WYNNE SAYER on the promising start that has been made, and publish his report in another part of this number.

While on the subject of the Indian Sugar Committee, it may be well to refer to a curious statement, met with in some papers,¹ that the Government of India proposes to start a great Sugar Corporation for the purpose of growing improved canes and making white sugar. Anyone who knows anything about the policy of the Indian Government will have received this report with a good deal of scepticism, and it is obvious that confusion has arisen between the Sugar Committee's activities and the Indian Sugar Corporation floated by Messrs. TATA, with

¹ E.g. *Sugar*, December, 1920, 706, and *American Commerce Reports* (I.S.J., 1921, 284).

a capital of some five crores of rupees (practically equal to £5,000,000 sterling). This is a very different thing. This Corporation has entrusted a large part of its management to the well-known sugar expert, Mr. NOËL DEERR, and we wish both it and the Sugar Committee all success in their different efforts to place the sugar industry in India on a firm basis.

Sir John Burchmore Harrison, C.M.G.

A couple of months ago we drew attention to the eminent services rendered by Sir FRANCIS WATTS, K.C.M.G., to the sugar industry of the West Indies. It was with peculiar pleasure that we read the name of Professor HARRISON, of British Guiana, in the list of birthday honours as having been made a Knight Bachelor. These two chemists have been prominently connected with the sugar industry for many years, and the Government is to be congratulated on having selected both of them for such signal honour. Sir JOHN HARRISON, who is a member of Christs College, Cambridge, took his science tripos as long ago as 1877, after which he was engaged in chemical and agricultural research at Cambridge and Rothamsted for a couple of years before taking up tropical work in Barbados. After about ten years in that island, during which his name became closely connected with the re-discovery and development of seedling canes, he migrated to British Guiana, where he became the head of the chemical and agricultural work of the colony, and has remained there ever since with comparatively short periods of absence on leave. Trained at a time when education in our universities was less dominated by specialized examinations, he was encouraged to take wide views, and developed into one of those old-time science men who could take up almost any line of work and make distinct advances in it. This is very evident in a review of his many contributions to science and to the development of his colony. Primarily a chemist, he gained distinction in the botanical work of raising new seedling canes which renovated the sugar industry when the Bourbon cane showed signs of dying out; as a geologist of repute he made many surveys in both of his colonies, studied closely the gold industry in British Guiana, and discovered the vast stores of bauxite which have become one of the chief exports of the country; as an agriculturist he has placed the difficult problem of manuring the fertile lands of Demerara on a sound basis, and made illuminating studies in the origin and composition of the soils of the north of the South American continent. But it is impossible here to give even a list of his various activities, and the cases mentioned are rather intended to indicate the wideness of his range of studies and the importance of his contributions to the development of his colony. We understand that Sir JOHN is about to relinquish his post in British Guiana and to return to this country, where we trust that he may long be spared to enjoy his well-earned rest. Meanwhile, we congratulate him on the successful foundation of the new experimental station in the colony.

The Vexed Question of Labour.

One of the results of the great war has been the recognition of the rights of man down to the meanest labourer. Labour conditions are thus rapidly changing all over the world, for all nations have had to call on their manhood for protection and thus have shown how dependent, in the last resort, they are on healthy human lives. In sugar growing countries the labour question is everywhere receiving serious attention, and even in Java, with its millions of contented workers in the fields, we occasionally read of labour troubles. But in other less favoured regions the relations with the workers, always difficult, are becoming an acute and intricate

Notes and Comments.

problem and all sorts of devices are being considered to deal with the matter. There would appear to be two main and contradictory tendencies for the solution of the difficulty, the one being to increase efficiency by better training, improved implements, better social conditions, and thus more firmly attaching the workers to the estate, and the other for the estate to divest itself of all responsibility by dissociating the plantation work from that of the factory, through the encouragement of some form of cane-farming. The relative advisability of these two methods will depend of course on the character of the people and the conditions of the country, but there can be no doubt as to which of them will tend to increased efficiency in the field and with it the productivity of the land and a larger return of sugar to the acre. Economists are busy all the world over with a study of this question, and an interesting paper lies before us by Mr. ALWYN SCHMIDT on *Labour Efficiency in the Sugar Industry*,¹ in which he takes as his text the *Report on the Conditions of the Sugar Industry by the United States Department of Commerce during the year 1917*. This naturally deals with Hawaii, Cuba, Porto Rico and Louisiana, but the lessons learnt may be applied to all tropical and semi-tropical sugar growing countries. During the year under report, the last in which such a comprehensive statement has been issued, it is pointed out that the average cane production to the acre was 43.92 tons in Hawaii, 21.32 in Cuba, 20.45 in Porto Rico and 18.29 in Louisiana. The sugar produced per acre was 10,992 lbs. in Hawaii, 4,912 in Cuba, 4,539 in Porto Rico and 2,616 in Louisiana. A ton of sugar was obtained from 8.14 tons of cane in Hawaii, while the figure for Cuba was 8.68, for Porto Rico 9.01 and for Louisiana 13.96. The planting, cutting and harvesting cost more in Hawaii than in the other countries named. In Hawaii 88.51 per cent. of the cane was planted, cultivated and harvested under full control of company's management, whereas, on the opposite side, in Cuba 80 per cent. of the canes were grown by farmers or colonos practically independently. The methods of cultivation were imperfect and the cultivation itself was largely neglected in the latter country. The writer claims that the case for increasing the labour efficiency is very clearly made out by these figures, for where the efficiency is low so are the returns, and the converse is true. He then analyses the work on some of the Hawaiian estates and pleads for much greater attention being paid to a settled policy of improving the conditions of the workers and at the same time reducing to a minimum all violent fluctuations in the character of the employment of the individuals of the labour force. The Report in question should be widely read.

The Situation in Cuba.

The outlook in the Cuban sugar industry has recently been anything but a bright one. The crisis of last year brought a great shortage of money in its train, and this has made the task of funding the present crop one of great difficulty. Labour has realized the situation and has reluctantly accepted lower wages which, in some cases, have not even been paid in full for lack of ready cash. The shortage of money is increased by the fact that only a part of the crop has been sold to date. In the warehouses and in the sea ports there are nearly 1,500,000 tons of sugar awaiting purchasers. Until the greater part of this accumulation is turned into cash, the situation in Cuban sugar circles will remain tight.

Our Havana correspondent writes that considering the late start of the present crop and the very difficult period the industry is passing through, the crop figures to the end of May had made very excellent showing. At that date the sugar

¹ *Sugar*, March, 1921, pp. 138-140.

delivered to the ports amounted to 2,703,956 long tons, or only 310,176 tons short of last year's figures, the number of factories grinding being 76. He considers it safe to assume that a further 580,000 tons of sugar will reach the ports, making the total crop this season, say, 3,283,856 long tons. From one cause and another quite a number of the mills will have to close down without completing the reaping of their canes; in other words, large areas of standing cane may be left over to the next crop.

The prospects for a large 1921-22 crop are not too favourable. For lack of money little or no cultivation is at present being undertaken in the canefields, and grass and weeds are simply allowed to grow. The whole aspect of the country is one suggestive of abandoned plantations. The next crop is therefore bound to be of reduced dimensions, but it is not anticipated that the deficiency will be as marked as the present neglect suggests. The crux of the situation will arise in the subsequent season. The present off-season expenses are being reduced to a minimum, which means that the coming crop will cost little beyond the usual harvesting expenses to cut, so the sugar will work out at a low production rate which will enable it to be marketed under favourable circumstances. But the profits accruing from this sale will probably need to be expended largely on bringing the land back into condition and in replanting abandoned areas for the 1922-23 season.

All this suggests that a time of stringency must continue in Cuba for a couple of years at least, and we fear a good many sugar properties will change hands at a sacrifice before that period expires; but with the wonderful climate and rich soil that characterizes Cuba, the industry should face the future with every confidence in its ultimate recovery.

The Sugar Industry in Poland.

According to a report of the Department of Overseas Trade, there were before the war 53 sugar factories in Congress Poland, 20 in Posnania, and six in Pommerellen. Out of these 37 were working in Congress Poland during the season 1919-20, 16 in Posnania, and six in Pommerellen. The yield of sugar in 1919-20 was very poor for the whole of Poland; in fact, it was the worst in the history of the sugar industry in this country. It was anticipated that the 37 sugar factories in Congress Poland would produce 24,606 tons of sugar and the 16 in Posnania 49,213 tons. The early frosts and snow in 1919, lack of fuel, and also the delay in supplying the factories with indispensable materials reduced these quantities by about 50 per cent. The prospects for the 1920-21 season are much better. Forty factories in Congress Poland are in working order, and three are in course of reconstruction. In Posnania and Pommerellen 24 factories are working and two have been restarted in Galicia.

The sugar industry holds the leading place amongst the industries based on agriculture, and is capable of considerable development; sugar will become an important article for export. In spite of the small production, Poland has so far succeeded in exporting to France and Great Britain the following quantities of sugar in exchange for fertilizers, phosphates, etc.: 1919-20, 6000 tons to Great Britain; 1920-21, 15,000 tons to France; 1920-21, 17,000 tons to Great Britain.

Some of the sugar machinery is made locally, the remainder for the most part being purchased in Germany. The Association of Sugar Refiners is however anxious to place their orders in Great Britain, and negotiations with a view to interesting British capitalists in the Polish sugar industry took place in 1920, but unfortunately did not materialize.

Fifty Years Ago.

From the "Sugar Cane," July, 1871.

In its issue of June 17th, 1871, the *Produce Markets Review* had published an article in which it stated that "the idea is maintained in the face of all reason that it is best for the planters to make the worst sugar as badly as possible, in order that it may be suited to the needs of the British refiners." It was asserted that this view was supported by the *Sugar Cane*, which "is therefore anxious to save the planters from the mistake of crowning their improvements by making good sugar with which to appeal direct to customers, and thus to pass by the pieces makers."

A reply to these allegations was made in this number by the Editor of the *Sugar Cane*, who without difficulty showed that there was not the slightest truth in them. He pointed out the obvious fact that it was in the interest of the refiner to buy the best sugar obtainable for his money, and only when the market was much depressed was it worth while purchasing the lower qualities, adding that "of course if planters could make refined sugar profitably, the refiner's occupation would be gone, but this is no more likely to take place generally than that the cotton planter should become a cotton spinner. . . ." Moreover, the *Produce Markets Review* was reminded that even in those days the *Sugar Cane* had advocated a progressive movement both in agriculture and in manufacture, and had published at intervals articles drawing attention to the advantages of central factories.

Fifty years ago maceration and imbibition were hardly practised, except perhaps in Louisiana. An article in this issue on sugar machinery pointed out that mills at that time did not extract more than 60-65 per cent. of the juice in the cane, factories often being content with as low a result as 50-55 per cent. An apparatus termed an "Affusor," the invention of Mr. ALFRED FRYER¹ was described. After leaving the mill, the bagasse was passed between rollers, the first four or five pairs of which were placed in a vessel containing water, while the points of contacts between the last one or two pairs were above it. In this way the crushed cane was alternatively pressed and released under the water, and later as much of the moisture as possible removed by the rollers above the water level. A simple method for the control of the milling efficiency was also recommended.

Mr. W. WADSWORTH set forth the advantages of growing melons for the manufacture of sugar, as compared with beets. "Deep ploughing was unnecessary; cultivation costs were only about one-third; the yield was 8 per cent. against 7 in the case of the amount obtainable at that time from the roots; the juice was purer, and the sugar could be crystallized from the syrups with greater ease than in the case of the beet. Moreover, melon seeds yielded 16 per cent. of an oil bringing a good price.

Other articles which appeared in this issue of our predecessor were entitled: "Defecation of Beet Juice" by L. WALKHOFF, according to which only about $\frac{1}{2}$ per cent. of the roots of lime was added at about 180°F. (82°C.); "Cultivation of Beetroot Sugar in Ireland" by the Rev. Prof. J. JELLETT, the inventor of the half-shadow device, who said that roots examined with the JELLETT polariscope had shown sugar contents varying from 9.5 to 12.6 per cent.; and lastly on "French Central Factories," where it was mentioned that the idea of a central factory was first suggested in 1838 by the firm of DEROSNE & CAIL to M. VINCENT, of Bourbon, who put it into execution in Réunion and later in Guadeloupe.

¹ English Patent, 1078 of 1869.

The Sugar Corporation of India.

It is with considerable attention that all who are interested in the Indian sugar industry are following the initial stages of the great company formed by Messrs. TATA, of Bombay, to exploit the sugar resources of the country. With this great venture, and the active enquiries being made by the Government of India through its Sugar Committee, we should in a few years' time be able to form a sound view as to India's possibilities with regard to this staple. Onlookers in this country may be roughly divided into the optimists and the pessimists, as to any sudden great expansion in India. While the former have drawn attention to the vastness of the sugar area (somewhere about 3,000,000 acres) and the large indigenous supplies of labour, they have ventured to prophesy that, with improved methods of manufacture, India, instead of importing large quantities of sugar each year from Java and elsewhere, should be able not only to meet its own requirements but supply the British Empire with all the sugar it needs. But we look in vain for any constructive proposals as to how this most desirable end should be brought about. The "pessimists," on the other hand, with a larger and more detailed knowledge of the country, have pointed out that it is extremely difficult to alter the highly specialized indigenous agriculture of a country; and furthermore, that the great sugar tract of India, lying outside the tropics, is unable to grow the better kinds of sugar cane profitably. Besides this, beyond the sporadic efforts dotted over the past hundred years, there has been a remarkable shyness of capital to exploit the undoubted possibilities, and there is no indication on the part of the native cultivators and manufacturers to alter the class of sugar produced—the impure jaggery or *gur* which enters so largely into their daily food.

The Indian Government meantime is fully alive to the situation, and has noted the fact that sugar is actually imported into the country, or has been, to the extent of nearly a million tons in a year; and, arguing that the country should at least be self supporting, has appointed a Committee thoroughly to investigate the matter, and to make suggestions whereby the industry may be placed on a better basis. Special officers were some years ago appointed to deal with the manufacturing and plantation sides, with the result that it is considered that the kind of cane grown in the sugar tract may be greatly improved, while better methods of making the sugar are constantly being brought to notice. Progress along these lines is certain if slow but, with the advent of the India Sugar Corporation, attacking the problem from the commercial side, there is every prospect that advances will be more rapid. The complaint that capital is not forthcoming is no longer tenable, for the Corporation has ample funds at its disposal for all eventualities (to the extent of £5,000,000 if necessary). Every effort has been made to obtain the best possible technical and scientific advice, and large salaries have been offered to ensure this: we may in this connexion merely note that Mr. NOËL DEERR is in their employ busily settling the matter of factory outfit, and with his experience no better selection could have been made. But according to our present information the Corporation has decided to confine its endeavours to the restricted areas where thick tropical canes can be grown, and the vast sugar tract in the north is being left severely alone. Let us hope that the Corporation will be a great success, for it is quite possible in that case that, with the experience gained, other capitalists will be tempted to turn their attention to the large areas where sugar cane is grown north of the Ganges. This great tract comprises the main sugar region of the country, and it is not likely that this dis-

The Sugar Corporation of India.

tion will be altered in the immediate future. At present, with the exception of the promising plantations in Bihar and a few concerns elsewhere, the whole of the sugar cane grown in the Punjab, the United Provinces, Bihar and Bengal is made into *gur*, and we must wait for the Sugar Committee's report before we can make any forecast as to the possibility of making white sugar on any extensive scale in these Provinces.

C. A. B.

The Agricultural Research Institute, Pusa.

Report of the Secretary of the Sugar Bureau.¹

(WYNNE SAYER, B.A.)

I was placed on special duty for a period of two years with effect from 20th January, 1919, to undertake the collection of all available information in connexion with the sugar industry in India, pending a further consideration by the Government of India of the question of establishing a Sugar Bureau. An establishment of two recorders, two clerks, and two typists, with one superintendent, was sanctioned to enable me to carry on the work, but one of these posts has been vacant for the whole time, the pay and the temporary position not being sufficient to attract a suitable man. The designation of my post was changed to that of the Secretary, Sugar Bureau, with effect from 13th April, 1919.

It will not be out of place here to give a brief history of the successive steps Government have taken to encourage the industry, in the course of which this office came to be created.

Scientific work on the sugar cane crop was started at Manjri in the Bombay Presidency by Mr. MOLLINSON in 1894, and at Samalkot in Madras by Dr. BARBER towards the close of the last century. In these two Presidencies some valuable results were obtained. In Bengal and the United Provinces also some work had been done. But it was after the Agricultural Departments were re-organized by LORD CURZON's Government in 1905 that the foundations of the important work being done by Mr. G. CLARKE at Shahjahanpur, Mr. SOMERS TAYLOR and the late Mr. WOODHOUSE at Sabour, Mr. MEGGITT in Assam, Mr. CLOUSTON in the Central Provinces, and Mr. ROBERTSON BROWN at Peshawar in the North-West Frontier Province, were laid, while the work already in progress in Madras and Bombay was expanded.

In 1911 PANDIT MADAN MOHAN MALAVIYA moved a resolution in the Imperial Legislative Council recommending that the duty on imported sugar should be so raised as to make it possible for the indigenous sugar industry to survive the competition to which it was exposed. The late Mr. GOKHALE moved an amendment recommending that Government should order an enquiry by a Committee of competent persons into the present condition of the sugar industry in India with a view to ascertaining what action could and should be taken by the State to save the industry from the threatened ruin. He pointed out that there was a great deal that Government could do for the industry even if it did not impose a high protective tariff, in the matter, for instance, of making the services of expert chemists available, in the matter of the terms on which land might be held, in the matter of irrigation and other facilities, and so forth. Government replied that they were alive to the position and were doing their best to improve the methods of cane cultivation and the manufacture of sugar throughout the

¹ Taken from "Scientific Reports of the Agricultural Research Institute, Pusa." 1919-20.

country. Both the resolution and the amendment were lost. But in November of the same year the question of the Indian sugar industry was considered by the Board of Agriculture in India, and as the result of its recommendations the appointments of a Sugar Cane Expert and a Sugar Engineer were sanctioned for a term of years. The headquarters of the former officer were located at Coimbatore in Southern India, as canes were found to flower there (this is not the case in Northern India), facilitating thereby the work of raising better varieties of canes by crossing. The Sugar Engineer was stationed in the United Provinces where more than half the total acreage under the crop is grown, his duties being to work out the smallest economical size of a sugar factory suitable for Indian conditions and to advise the public on factory matters. As stated above, both these were on a temporary footing. Nevertheless they marked a stage forward in the policy of developing the Indian sugar cane industry. Since then almost every meeting of the Board has reviewed the work done on this crop at the various experiment stations in the country.

The great European war brought the question of the Empire sugar supply to the forefront. The usual sources of beet sugar supply—Germany, Austria-Hungary and Russia—having been cut off, the world was faced with a serious shortage of sugar, and India in common with the rest had to pay heavily for her imports. It was in these circumstances that the Board of Agriculture met at Poona in December, 1917, and the opinion was unanimous that the time was ripe for making a further move in the policy of developing the Indian sugar cane industry. It was the general opinion of the Board that no time should be lost in starting an office where information on all aspects of the Indian sugar industry could be obtained, the information available at that time being scattered in the Secretariats of the various Governments in India, in the records of the late Reporter on Economic Products to the Government of India, and in the offices of the Director-General of Commercial Intelligence, the Government Sugar Cane Expert, and the Directors and Deputy Directors of Agriculture in the provinces; this information was to be collected, sifted, reviewed, and made available to Government and the public. In view of the prevailing high price of sugar acting as an incentive to putting up factories in the country, it was most desirable that there should be a central organization where reliable information, advice, and assistance could be had.

It will thus be seen that the formation of this office was a natural evolution of the series of steps which the Government had already taken for the improvement of the Indian sugar cane industry. The appointment of the Indian Sugar Committee during the year by the Government of India, with the Secretary of State's approval, marks a further step in the same direction. It is expected that the Committee will submit definite recommendations as to the Sugar Bureau's constitution and functions, its relation to the provinces, and where it should be located.

The first piece of work undertaken by me was the collection and indexing of all available literature on the subject published in India, sifting the masses of information available in various offices, and arranging them in a form convenient for reference. Much progress has been made in this direction, but it was impossible to pay undivided attention to this part of the work as numerous correspondents began to seek advice as soon as the office was established, and I was in charge of the duties of the post of Imperial Agriculturist up to 4th January, 1920, and was also appointed a member of the Indian Sugar Committee. Enquiries relating to sugar and sugar cane began also to be transferred to this

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office by the Agricultural Adviser to the Government of India, the Government Sugar Cane Expert, Director-General of Commercial Intelligence, and other officers. The enquiries range from mere requests for statistical information regarding acreage, yield of sugar cane per acre and imports of sugar in India, to varieties of cane, methods of cultivation, manures required, localities where sugar factories can be put up, the machinery required and how to get it, etc.

As it is most essential to have an up-to-date library for a central place of reference like this, steps have been taken to lay the foundations of one which will grow in future. During the year under review, 1448 volumes have been received either by purchase, exchange, or free supply, and they are being continually added to. Scientific and other periodicals bearing on this industry are being subscribed for.

During the year under report I placed myself in touch with almost all the sugar experiment stations of the world, the principal sugar machinery manufacturers in Great Britain and the United States of America. In India I am in touch with all the sugar factories and also with the officers of the provincial Departments of Agriculture connected with sugar and sugar cane.

As mentioned above, I have been appointed a member of the Indian Sugar Committee in addition to my duties as Secretary, Sugar Bureau, with effect from 26th October, 1919. This has given me a further opportunity of getting first hand knowledge of the existing state of the Indian sugar industry.

On 14th May, 1920, I and the Superintendent of my office, Rao Sahib KAZANJI D. NAIK, proceeded with the Sugar Committee to Java. Here the opportunity was taken of inspecting all the libraries in the experiment stations and in the office of the Secretary to the Java Sugar Syndicate. A great deal of literature was collected, and numerous points on which we were uncertain as to the methods adopted in Java were cleared up. I also brought back with me a collection of the latest Java varieties, including a cane specially recommended for North India by Dr. JESWIET, Sugar Cane-breeding Expert, Pasoeroean Experiment Station, which have been sent on to the Coimbatore Cane-breeding Station for planting. I have also arranged, by the kindness of Dr. JESWIET and Dr. KUYPER, officiating Director of the Pasoeroean Experiment Station, to get any crosses done of canes which do not flower in India. It is anticipated that this will be of invaluable assistance to the sugar industry in Bihar, as no crossing has hitherto been possible with the Mungo family which up to date has refused to flower in India.

According to an American commerce report, Spain manufactured 200,000 tons of sugar during the past season. The normal consumption of the country is stated to be 140,000 tons. It is said that 300,000,000 pesetas of Spanish capital are invested in the sugar industry, that 200,000 families are employed, and that 250,000 tons of coal are consumed annually in the manufacture of the sugar.

Subscriptions are invited by the Darco Corporation to manufacture "Darco" decolorizing carbon from lignite in Louisiana, using a 6000-ton per annum plant and cheap oil or gas fuel for heating purposes. Patents¹ and processes have been acquired by the corporation, by means of which a preparation of very high power can be produced at a lower figure than hitherto. It is believed that this carbon may be the standard material for sugar refining in the future as boneblack is to-day. In addition, such a material would be in demand by sugar manufacturers for plantation whites; by candy makers for converting their waste syrups into a white product; by fruit canners; by glucose, maltose, and lactose manufacturers; as well as in the production of oils and fats, gelatin, glycerin, alcohol, alkaloids, fine chemicals, etc.

¹ Those taken out by DEMME are mentioned. See *I.S.J.*, 1919, 253.

The Royal Commission on the Sugar Supply.

Further Report on Operations to March 1921.

The second report¹ on the operations of the Royal Commission on the Sugar Supply, bringing its history down to March 1921, when State control of the sugar supply of the United Kingdom ceased, has just been presented to Parliament and published (Cmd. 1300). It is too long to reproduce here verbatim, but we give below a summary of its contents where we do not quote it in extenso.

The Report begins with a reference to the changes in the composition and functions of the Commission which have taken place since December 1916 when the last Report was issued. At that date Mr. R. McKenna had vacated the chairmanship, and a Ministry of Food was created to which the Royal Commission, while being left free to exercise its functions in relation to the maintenance of the sugar supply, had to hand over the task of regulating the distribution of the supplies to the consumer. To assist matters in this connexion, LORD DEVONPORT, the new Food Controller, was appointed to the vacant chairmanship of the Commission. After Lord Devonport's retirement in June 1917, LORD RHONDDA occupied the position of Food Controller and was at first inclined to incorporate the Commission into the Ministry of Food. But on learning that none of the existing members of the Commission would be disposed to serve in the subordinate capacity that such new conditions would place them in, he decided to leave matters as they were, and appointed Sir CHARLES BATHURST (subsequently LORD BLEDISLOE) as the new chairman of the Commission. LORD BLEDISLOE remained till April 1919, and then was succeeded by Sir HENRY PRIMROSE.

The Report then goes on to deal with the first measures of control which the Commission exercised over the retail sale of sugar when supplies became curtailed owing to the U-Boat campaign. A voluntary system of rationing was at first instituted by LORD DEVONPORT, fixed at 12 oz. per head per week. This measure was serviceable up to a certain point and might have been more so, in the opinion of the Royal Commission, if LORD DEVONPORT had allowed the retailers, as they wished, to restrict the sale of sugar to persons who purchased other goods at the same time. In the absence of such a restriction sugar queues "formed largely of selfish and even of idle persons" cleared out the stocks in the shops and left nothing for the end of the week when working class purchases were principally made. So something more drastic became necessary, and in January 1918 an elaborate and necessarily expensive compulsory system of rationing was introduced which made a heavy addition to the duties that the Royal Commission had to perform. The Report gives us some observations on the rationing system such as the experience of the Royal Commission suggested.

OBSERVATIONS ON THE RATIONING SYSTEM.

"The system was, in our opinion, very skilfully devised, and was theoretically thoroughly coherent and complete. It worked with a satisfactory measure of efficiency, although no one could venture to claim that in practice there were not substantial deviations from what an exact application of the theory of the system would have required. Further, it had the advantage of ensuring the holding by retailers of stocks, sufficient for three or four weeks' consumption, which could be drawn upon in the event of interruption of transport facilities. This proved extremely useful in September, 1919, at the time of the railway strike. But without

¹ The first Report appeared in 1917. See *L.S.J.*, 1917, 451.

The Royal Commission on the Sugar Supply.

question it was immensely expensive; and we think that, should occasion again arise for regulating the consumption of food, it might be worth while to consider whether the objects in view could not be attained, perhaps with somewhat less efficiency, but at a cost so much less that it would compensate for some loss of efficiency, so long as the system adopted provided an adequate measure of effectiveness. We recognise that the rationing system which was employed must be taken as a whole, and we are conscious that, our experience being limited to the single commodity of sugar, we are not qualified to form a judgment in respect of the system as a whole. All the more is this the case, because the commodity of our experience differs from all other food commodities (except tea and certain fruits and special articles), in that the whole quantity consumed is imported, whereas with nearly all other foods a portion is produced at home, and only a portion imported. Nevertheless the whole is only the aggregate of the parts, and it may be worth while to consider the part with which we are familiar, even though it be but a single part, and in the above respect a peculiar one.

"The question which we suggest as deserving of consideration is whether for regulating consumption enough could not be done by applying control only to the purveyors of food, without extending it to every individual in the community. In a case such as sugar, with Government as the one and only source of supply, the power to withhold supplies places in the hands of the department managing the business a most effective means of controlling all persons dealing in the commodity; and if such control could be made adequately effective, the expense of exercising it over a limited number of persons would obviously be much less than if control were extended to all the millions of the population. We are inclined to think that, with sugar at any rate, such a system could be made adequately effective. Nothing was more gratifying to us during the war than the general, we might say the universal, readiness displayed by all the traders with whom we were brought into contact to accept and promote any measures that were thought necessary or desirable in the public interest. Given that spirit of helpful co-operation among the persons and interests affected, we think that a relatively slight extension of the control which was actually applied to traders might very largely obviate the necessity of issuing regulations for the individual consumer. The point, however, is one on which it would be difficult to pronounce a decided judgment without close and expert investigation: and we mention it only as one that might deserve consideration at some future time, and not as in any way suggestive of adverse criticism of what was actually done in the late war."

PURCHASES.

The change that took place in 1917 in the conditions affecting the purchase of sugar owing to the U-boat campaign is shown in Table I appended,¹ from which it will be seen that from that time forward the great bulk of supplies had to be drawn from the countries of production in the Western Hemisphere. "The exigencies of exchange, and still more of freight, made recourse to Eastern sources almost impossible, and it was only with great difficulty that in 1917 we were able to arrange for the purchase in Java of 360,000 tons of that year's crop, while in 1918 we were compelled to forego altogether purchases in that country, with the tantalizing result that while we were obtaining nearly all our sugar from Cuba at an f.o.b. cost of 21s. 7½d. per cwt. there were large stocks accumulating in Java which might have been had at an f.o.b. price of 9s. 8d. per cwt. By the middle of 1919, the prices of sugar in Java were five or six times what they had been a

¹ Owing to the length of this Report we are unable to find room in this issue for several of the Tables; these will, however, appear in our August issue. [Ed., I.S.J.]

year before, and were on a level with, and even above, those of Cuban sugar. The year 1918 offered a tempting opening for speculation; but it would not have been a legitimate application of public funds to use them for making purely speculative purchases.

"On the entrance of America into the war, the President appointed Mr. HOOVER as Food Administrator, for the better regulation of food supplies and consumption. Mr. HOOVER was not long in coming to the conclusion that it would be necessary to obtain complete control over the sugar supply from Cuba and San Domingo, as well as from the States themselves and their dependencies; and to this end he proposed the creation of a Board to consist of three representatives of the United States of America, and two representatives of the British Sugar Commission, which should negotiate all purchases in those markets, and should allocate the supplies obtained equitably between the European countries of the Alliance and America. To this the Commission readily assented, subject to the proviso that it should itself remain, with independent authority, as the purchasing body in the British West Indies and Demerara, in the East, and in South America. SIR JOSEPH WHITE TODD (a member of the Commission) kindly consented to our request that he would act as the senior of our representatives; as his colleague, we secured the services of Mr. JOHN RAMSAY DRAKE, senior partner in the firm of J. V. Drake & Co., sugar merchants and agents, of Mincing Lane. . . . These gentlemen left for New York in October, 1917, and during November and December the new Board, which received the title of 'The International Sugar Committee,' was engaged elaborating arrangements in pursuance of the contemplated policy. The Commission's representatives were concerned in only so much of the scheme as related to the acquisition and distribution of the 1917-18 Cuban crop, and their influence was directed mainly to two points, viz., keeping down as much as possible the price to be paid, and securing that the European allies should receive a full share of the crop, and under suitable conditions of contract. In the result it was arranged that the price to be paid to Cuban planters should be \$4.60 per 100 lbs. f.o.b. at northern ports and \$4.55 at southern ports; that the Committee should bind itself to take 2,500,000 tons of the crop, and should have options over any balance of the total crop available for export (estimated at 3,200,000 tons); and that the countries of the European alliance should participate up to the extent of one-third on each section of the contract, which was embodied in an Agreement executed by the Food Administrator, the International Sugar Committee, the British Sugar Commission, the Cuban Government, the Cuban Planters, and the Associated Sugar Refiners of the United States of America.

"It will be seen what a revolution this meant in the business of sugar purchase. But obviously nothing less could have sufficed, as without combination between the purchasers, the Cuban planters would have been in a position to extort almost any terms from buyers. In the circumstances the Commission was satisfied that the price as fixed was a reasonable one, and one calculated to give to producers no more than a legitimate margin of profit, having regard to the increased cost of all instruments of production, and more especially to the scarcity and high price of labour in Cuba. A similar arrangement was made in respect of the 1918-19 crop, but not by the same parties, nor at the same price. The purchasing authority was a new body called "The Sugar Equalization Board." Neither the British Foreign Office nor the Commission was consulted by the American Government in respect of the formation of this body, which was no doubt rendered necessary by the internal situation in the United States of America resulting from the entrance of America into the war: but we were given

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to understand that the new authority would continue the policy of associating the interests of the Allies with those of the United States. So far as we could, we exerted our influence for the purpose of limiting the increased price to be paid to Cuban planters to an advance of 50 cents. per 100 lbs. over the 1918 price, which seemed to us sufficient. The Board, however, eventually fixed the price to be paid at \$5.50 per 100 lbs. f.o.b. northern ports and \$5.45 per 100 lbs. southern ports respectively; representing an advance not of 50 cents but of 90. Unquestionably the considerations in respect of labour and the rise generally in cost of production had increased in force, and on that point the authorities in America were naturally more fully informed than we could be, and were entitled to be the final arbiters. For the purpose of securing our interests in other respects under the new Board of Control we were fortunate enough to obtain the assistance of Mr. DRAKE, who for the second time, and again at much personal inconvenience, placed his services at our disposal. He sailed for America at the end of October and returned at the end of December, after having successfully negotiated on our behalf an agreement with the Sugar Equalization Board on terms eminently satisfactory to us.

"Towards the end of 1919, it for long remained in doubt whether the American Government would continue the Sugar Equalization Board, and it was not until December that it was finally known that the Board was to cease active operations, and that the Cuban sugar crop of 1919-20 would be left free from control for its marketing. The effect was to open wide the door to speculation, and the impulse to it was enhanced by disclosure of the fact that the coming crop was likely to be much less abundant than had been anticipated. The uncertainties of the market were so great as to cause us serious embarrassment, and to aid us in forming a judgment as to the future course of prices we availed ourselves of the assistance of Mr. GILBERT FOX, of the firm of Edward Grey & Co., of Liverpool, who was proceeding to New York in November, and who willingly undertook the task of advising us as regards the situation there. He kept himself in close touch with the leading buyers of Cuban sugar, and found amongst them a universal opinion that the enhanced prices that the planters were demanding were excessive, and that the proper policy for buyers to pursue was to remain aloof until the pressure of stocks in the Cuban ports should compel planters to accept lower prices. We were strongly urged to conform to this policy; and obviously it could only succeed if generally followed by all large buyers. We therefore confined our purchases to the lowest limit consistent with the maintenance of an uninterrupted supply. The policy failed in its purpose; and from the beginning to the middle of 1920, prices mounted with startling rapidity until, in May, they reached the extravagant figure of 22½ cents f.o.b. Cuba. During this excited period our total purchases of Cuban sugar were only 20,290 tons, and the highest price paid by us for any one cargo was 18.15 cents. In July, 1920, we completed negotiations for the purchase of the whole Mauritius crop of 1920, thus rendering ourselves less dependent upon Cuba. The effect on the Cuban market was soon apparent, and prices straightway began to fall and continued for the rest of the year to decline, until by Christmas they had reached the low level of round about 4 cents per lb. At this price we bought 100,000 tons in January last. The price on 31st March was 4.95 cents."

TRANSPORT AND INSURANCE.

Freight for the conveyance of the purchases of the Royal Commission was provided throughout at blue-book rates, at first by the Admiralty and subsequently by the Ministry of Shipping. The Commission provided its own insurance, both of hulls and cargoes, by means of a percentage addition to the cost of cargoes.

The total of their losses came to the following :— Marine, 31,190 tons; War, 156,032 tons. The total amount charged against the insurance fund came to £7,688,900, which left a credit balance on the fund at 31st March 1921 of £2,172,000.

CONSUMPTION.

The total consumption of sugars sold under control was for the various years as follows :—

FOR	1915. TONS.	1918. TONS.	1919. TONS.	1920. TONS.
Domestic use, catering, etc.	1,194,000	579,288	790,881	576,980
War Office and Air Ministry	44,000	82,068	23,215	3,004
Admiralty	12,000	8,092	—	6,460
Navy and Army Canteen Board..	—	4,580	2,474	1,460
Wholesale jam manufacturers	130,000	216,828	200,552	51,916
Condensed milk	20,000	21,368	24,964	17,720
Drug manufacture	6,834	3,417	7,490	
Confectionery	151,632	41,750	166,198	
Pastries	60,172	15,043	65,952	
Biscuits	22,368	5,592	24,517	
Candied peel	4,612	1,153	5,055	
Mineral water	20,800	5,200	22,798	
Other beverages (excluding beer)..	7,380	1,845	8,089	
Other manufacturers	32,224	8,056	35,320	
Domestic preserving (in domestic)		18,012	68,459	33,640
Syrup manufacture	39,257	74,496	68,056	59,020
Brewing	73,209	22,049	50,855	51,116
Sales without vouchers, losses, etc.	—	1,068	34,129	42,800
	1,818,488	1,109,905	1,695,004	952,408

NOTES.

1915.—These figures are based primarily upon the results of the enquiry instituted at the inception of the rationing scheme.

1918.—These figures cover the period 31st December, 1917, to 28th December, 1918.

1919.—These figures cover the period 30th December, 1918, to 27th December, 1919, and include 19,526 tons, the allotment of which was delayed until 1920.

Domestic ration: 35 weeks at 12 ozs.; 15 weeks at 8 ozs.; 2 weeks at 6 ozs.

Average, 10·61 ozs.

1920.—These figures cover the period 29th December, 1919, to 25th December, 1920, and exclude 19,526 tons, the allotment of which was delayed from 1919.

Domestic ration: 13 weeks at 12 ozs.; 25 weeks at 8 ozs.; 9 weeks at 6 ozs.

Average, 8·61 ozs.

Yellow and brown sugar free during 15 weeks. Privately imported sugar, sold during 1919 and 1920 for manufacturing purposes other than syrup and invert making, is not included.

“For the years 1916 and 1917 before the rationing system came into force the appropriation of the supplies cannot be determined. In 1917 and 1918 and again in 1920, the total consumption was little, if at all, in excess of the quantities of refined sugar that the refineries of the country can turn out: consequently in those years the importations of refined sugar were reduced to a minimum. The larger consumption in 1919 was due in great measure to the fact that during a considerable part of that year the prohibition of private imports was suspended.”

STOCKS.

“The maintenance of sufficient stocks in the country, so as to avoid any risk of an interruption in the supplies available for consumption, has been throughout

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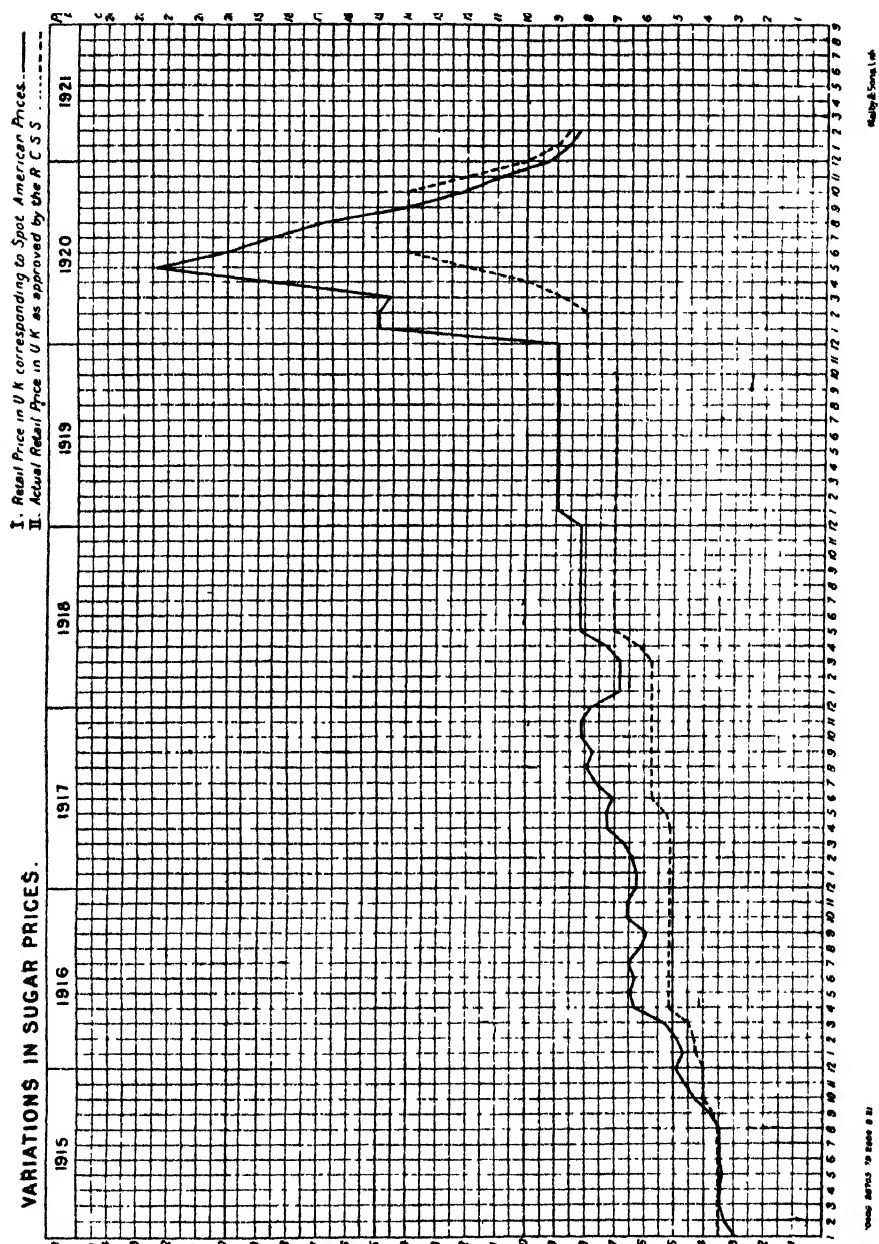
a point that has engaged the attention of the Commission. Prior to 1917 it was not of prominent importance, as supplies were plentiful, and transport presented no serious difficulties. But the U-Boat campaign of 1917 made it critical. In the middle of April of that year there was a moment when the stock in hand represented only about four days' consumption. In the 20 weeks from February 4th to June 23rd, 1917, no less than 80,000 tons of sugar were lost through submarine sinkings; and this unfortunately coincided with a period during which the Ministry of Shipping took upon itself the responsibility of allocating tonnage, not in accordance with the requisitions of the Commission and other importing departments, but in accordance with the judgments it had itself formed from a study of statistics, as to the relative urgency of the several claims upon the tonnage available. It was not until the duty of allocation was entrusted to a specially constituted branch of the Ministry of Food that the allotments of freight were placed on a satisfactory footing. Accordingly throughout the remainder of the year the Commission gave much attention to the subject and urged upon the Shipping Controller and other authorities concerned that, in view of the difficulties and dangers of transport, it should be regarded as a fundamental point of policy that stocks be built up to, and maintained at, a level which should be equal to two months' consumption, or about 200,000 tons. This was agreed to, and a programme of importation was arranged on that basis; but it was long before the desired standard was reached. Indeed in the earlier part of 1918 the deficiency in the imports of raw sugar was so great that in February the Commission was obliged to direct refiners to reduce their melts by 20 per cent., and it was not until the end of March that it was found safe to resume work to the full capacity of the factories. Later the desired position was not only reached, but surpassed.

"The stocks held by the Commission on 31st March, 1921, were, Raws 390,479 tons, Whites 57,787 tons, the raw being sufficient to supply our refineries up to the middle of July. The conditions under which the sugar is to be issued to the refiners have been settled by an agreement made between the Food Controller and the British Sugar Refiners' Association, under which the Refiners undertake not to use sugar imported on their own account until the Commission's stocks are exhausted, but to meet all their requirements out of these stocks and to pay for them at prices which an expert Committee is to fix week by week, at the equivalent as near as may be of the prices ruling at the moment in the world's market. No further purchases are being made by the Commission and the handling of cargoes still to arrive, the disposal of stocks, and the final winding-up of accounts, are all the business that remains for the Commission to carry out under its warrant."

PRICES.

The cost of the Royal Commission of their purchases of sugar on a c.i.f. basis is shown in Table II.¹ The report includes a diagram (reproduced here) "showing how the prices in the United Kingdom as approved by the Commission have compared, since the beginning of 1915, with what the prices would have been at any given moment, if they had been equal to the cost of spot American Granulated laid down in the United Kingdom at the time. It will be seen that since the end of 1915 the prices paid by consumers in this country have been consistently below those at which sugar imported at the prices of the day in the world's markets could have been sold, by a difference seldom less than 2d. per lb. and frequently more.

¹ See footnote on page 375.



"We ourselves cannot, however, regard this wholly as a matter of congratulation. In paragraph 16 of our First Report we thus summed up our aims as regards finance:—

'In a word, the Commission's financial policy has been to aim at so conducting its business that, when the Commission should be brought to a close, its operations should be found to have been carried out free of cost to the Exchequer, while not imposing upon the public any greater charges than might suffice to cover expenditure.'

The Royal Commission on the Sugar Supply.

"This aspiration cannot now be realised. But the fault is not ours. From time to time since the middle of 1919, the Commission has on various occasions pleaded for an increase in the selling prices of its sugars, so as to build up a reserve to meet the loss which it foresaw as probable on the liquidation of its stocks on the conclusion of its operations. But on no occasion has a rise been authorised until weeks or months after it was recommended, and then not always to the extent recommended. From a calculation we have made, we are able to say that if our recommendations (which were always kept as low as possible in view of the reluctance shown by the Cabinet to an increase in prices), had been approved at the time they were made, our receipts would have been £16,000,000 more than they have been in fact. Even that sum is less than the deficit which it is probable that the Exchequer will have to meet on our operations, and which we estimate at not less than £24,500,000. Some may perhaps hold that it is not of material importance to the public whether it has to bear a burden of this kind in its capacity as a taxpayer or in that of a consumer of sugar. But to us it is a matter of regret that we shall not be able to claim that we discharged the duties imposed upon us, without having recourse to the funds of the Exchequer otherwise than for the purpose of the temporary financing of our operations. The advances made to us under this latter head by the Treasury stood, on 31st March, at £27,281,937."

ESTABLISHMENT.

The cost of the Royal Commission's establishment, including salaries, rent, light and fuel, etc., from 1914 to 1921, came to £103,239. Of this the Commission write that the charges "will be found to compare very favourably with those of any of the many bodies which were brought into being for war purposes."

"Of the services rendered by our Manager and Secretary, Mr. J. J. RUNGE, it is impossible to speak too highly. On him fell the daily responsibility of co-ordinating all the arrangements for the transport of sugar purchases, the times and places of the loading of cargoes, and of their discharge; of regulating the the issues to dealers and manufacturers in accordance with the rules of distribution from time to time in force; and of dealing with difficulties that were constantly arising out of special circumstances due to the exigencies of some public emergency or of exceptional requirements on the part of individuals. Moreover, he acted as the principal intermediary between the Commission and the French and Italian Governments during the period when the Commission acted as Agents for those Governments, and his services in this connexion were so highly appreciated by the French Government that it conferred on him the distinction of Chevalier of the Legion of Honour.

"We have been able to avoid the establishment of branch offices in the provinces and abroad, thanks to the assistance given to us at the ports and in America by unofficial agencies. In Liverpool the Liverpool Raw Sugar Brokers' Association and the Liverpool Refined Sugar Brokers' Association have acted on our behalf in supervising the landing and distribution of cargoes; and in Glasgow and Greenock, the Glasgow Refined Sugar Brokers' Association and the Greenock Raw Sugar Brokers' Association have performed for us similar services, in each case both efficiently and economically and to our complete satisfaction. In America, Mr. LAMBORN, of the firm of Lamborn & Co., has from the first directed and supervised all the arrangements for the shipping of cargoes from Cuba and New York. Although not a British subject, Mr. LAMBORN has devoted himself to our interests with exemplary diligence and zeal; and has saved us from the heavy expense that we should have had to incur, if we had had to maintain a

shipping agency of our own in Cuba. In London the sale of our imported white sugars has continued to be conducted by the firm of J. V. Drake & Co., under the conditions described in paragraph 11 of our first Report; and they have in addition, of late years, undertaken supervision of the distribution and sales of a certain portion of British refined sugar, the allocation of which required to be made by our authority in order to maintain accordance with the scheme of distribution of the rationing system."

(To be continued.)

Meditations on Trapology.

The Rôle of the Steam Trap in the Sugar Factory.

By J. O. FRAZIER.

Sugar Engineer, New Orleans.

III.

Having given attention to a few representative types of the non-return steam trap, with some analyses of service, it is in order to consider the comparative intricacies of return steam trapping and economic values of such service. In the first place "Return" as applied to steam traps, implies—by custom—the return of steam condensation into the steam boilers of the plant.

Although somewhat numerous in kind, and with much variation in structural detail, all are basically the same in routine of operation, and all problems of adaptation, location, piping requirement, pressures and levels apply equally to each; all are "displacement" machines. Three primary features of this service are: There is a boiler pressure steam volume required equal to that of the water handled; steam equalization within the trap chamber with that of the boilers being fed; and location of the trap chamber above the boiler water level for gravity feed, which return steam traps accomplish. The only exception to the above is with the last requirement; elevation of trap above water line. This exception has a very limited application and will be considered in its proper place.

The special field for the return steam trap is in situations where there are large amounts of condensation much above atmospheric boiling point to be returned to the boilers as feed. Such, for instance, are sugar factories, salt works, etc., where large evaporation is carried on of water from solids in solution.

Condensation quantity being the chief determining factor in the application of return steam trapping, the following analysis of very usual sugar factory conditions will apply to cane factories and equally to beet factories with allowance for the greater dilution of the juices by the diffusion process.

Applying approximate quantities of evaporation about the cane sugar factory we have a showing of the quantity of condensation to be dealt with, also comparative evaporation in the steam boilers with that required in the case of the juices. Also, the average well-ordered factory uses all the steam generated at the boilers in evaporation of water from the sugar liquors. For this reason the measure of condensation to be returned is nominally equal to the water evaporated in the boilers.

Further, if we take a 2000-tons-cane-per-day sugar factory, at two horse-power per ton of cane per day we should have 4000 horse-power. If we take the moderate allotment of 30 lbs. water per horse-power per hour, we will have, in the boiler plant, 96,000 horse-power-hours per day; multiplied by 30 it will give us

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approximately 1400 tons of condensation per 24 hours to be dealt with. To reduce this to a better appreciable quantity, it will be 240 gallons per min. of water whose proper destination is the boilers.

The cane represented, and with very usual saturation used on the cane in milling, will make the juice weight nominally equal that of the original cane. With 85 per cent. evaporation from the sugar liquors there will be an evaporation in this department of approximately 1700 tons per day; reducing this, as above, will give 284 gallons per min. evaporation of water in the liquors. The excess of juice evaporation, over that of steam supply, is made up of the multiplication of evaporative value in the multiple effect. Both boiler and juice evaporation values are, of course, variables.

The use of return traps, under usual conditions, is based upon immediate (comparatively) return of condensation to the boilers in what is in reality a closed system. By the usual method of release into some non-pressure receptacle and subsequent pumping into the boilers, such released condensation must quickly part with the excess heat above atmospheric boiling point. The usually large radiation surface of such collectors, together with the excess time in transit—from coil to boiler—results in a further fall of temperature. To such an extent does this prevail that very many observations on sugar factory boiler feeds lead to the conclusion that the average feed temperature of sugar factory boiler water is not above 180°. It is worthy of mention that the probable time cycle, through the usual release and pumping systems, may approximate 30 minutes, while the circuit through the apparatus and a return trap system is probably something like five minutes. Also, all other things equal, the heat gain by the use of such system is approximately in proportion to the steam pressures used and their corresponding temperatures.

The first consideration, and an imperative requirement in all return steam trap operations, is that the pressure from which the drainage comes must be such as will force the condensation into the chamber of the trap, during its periods of no pressure; these are when filling. Such force may be either that caused by steam, or elevation as "head," both of which enter into the problem, the latter usually of much less consideration. When such initial force is not available, a duplex or 2-stage installation becomes necessary. This is shown further along as applied to the delivery of low-pressure water into the boilers from the effect heat belt.

Any number of return steam traps may receive their water from several sources of unequal pressures and delivery collectively into a common distributing feed main among several boilers of the same pressure, and from which pressure their equalizing steam is taken. Such collective delivery is possible because, during the period of discharge the pressure within each trap tank is the same as that of the boiler into which the feed is being delivered, and the filled trap chamber is above the water level of the boilers. Such inequalities of resistances as are met here are due to unequal boiler water levels and greater friction of flow into some than others. These are adjustable by manipulation of the feed valves.

In Fig. 6 is shown the simplest possible application of one return steam trap to one vacuum pan—in this instance. In this figure there is only a moderate approximation to proportion. A section of a pan bottom is shown with one of the coil drains *d*, emptying into the receiver *R*. All others, carrying the same coil pressure, are similarly connected. The route shown for the main drain *D* is only an arbitrary one, and this may follow the shortest or most convenient one. The inlet check valve of the trap is seen at *C*, below and to the left of *R*, the outlet

check valve on the same level at the right of *R*". There is a stop valve *S*" between the outlet *C*, and the boiler inlet which is through the tee, *T*. This feed is shown entering the regular boiler blow-off, whose valve is shown as *B*. The feeding at this point is very common, among American plants at least. When feeding into a mud-drum, *M-D* as shown, there is a tendency to maintain the temperature of this portion of the boiler nearer to that of the shell. At *Sp* is shown the equalizing steam connexion for the trap from the same boiler being fed. This from the steam drum *S-D*.

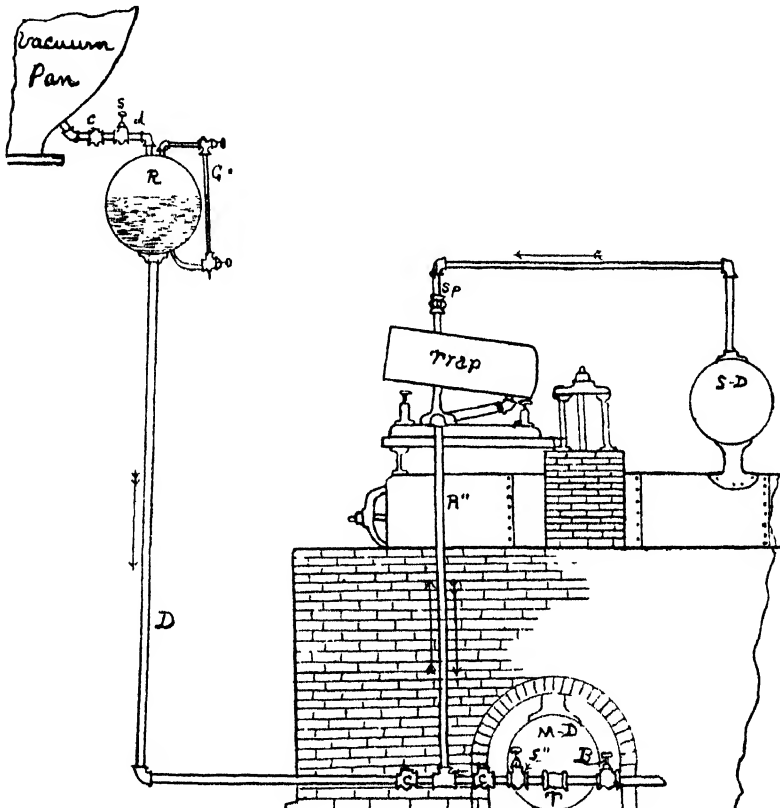


FIG. 6.

Refer to that portion of Fig. 6 near the pan; return steam traps being strictly intermittent in action, there must be accumulation of condensation during discharge periods. The office of the receiver is a storage for accumulations during interruption of flow. In correctly proportioned equipment, the water in the receiver will be seen to rise and fall alternately with the movement of the steam trap. An important secondary office of such receiver is that of an indicator as to the effectiveness of drainage. With the gauge glass, *G*, in view of the sugar boiler, it is easy to keep proper track of the conditions of coil drainage, or of calandria as the case may be.

At *c*, near the pan, is shown a swing check valve in place of the more common adjustable check; also there is shown a stop valve *s* near by. This latter, for the fullest opening, ought to be a gate valve. It is very usual American practice to

Meditations on Trapology.

use one return trap to any vacuum pan, unless the capacity required be greater than that of one trap. Or, in case of coil and calandria pans carrying two different pressures, or such as have alternating live and exhaust steam coils, different traps must be used for the several pressures.

There is much advocacy of a separate steam for each vacuum pan coil or similar service. In fact, so much has this theory prevailed that a very considerable majority of pans are so equipped. The theoretical accuracy of the multiple trap idea is not easy to dispute. It is based upon an apparent strong possibility of varying pressures in the different coils, even though all connected with a common steam distributing manifold, as is customary on coil pans.

In such multiple equipment it has been found rather more than common that all these traps may discharge into a common carry-a-way drainage main. In many cases these are of very considerable length. The very common result is that there is a very considerable back pressure against the discharge of these traps. This produces its capacity loss, in any trap, directly in proportion as the difference between the inlet and outlet pressures is reduced by the back pressure against the trap. With the very limited usual net valve opening of the non-return steam trap, combined with the above usual adverse condition of discharge, we find contributing factors toward the frequently observed fact that pans have been materially speeded up, in boiling capacity, by the substitution of one intermittently acting return trap for all coils, over its performance with one continuously acting non-return steam trap on each coil.

Referring again to Fig. 6 for a discussion of drainage conditions, the following analysis applies, and is confirmed by many observations on pans so equipped. Considering one-pressure coil pans we find a steam distributing manifold serving all coils. There are some tendencies toward slight variations of pressure in the several coils, indicating the propriety of individual traps. One of these tendencies is that of unequal heat transmitting capacity, due to more or less fouling of surfaces; another is the character of liquid surrounding the coil, and more particularly the variations in circulation movement of the heated mass. No adverse drainage has been observed from these certainly existent causes in the writer's experience.

A direct comparison of drainage in the two cases cited will show: First, that there will be the same pressure in the receiver *R* as there is in the pan coils. For this reason gravity drainage alone is in action, and a large and free connexion between coil and receiver is necessary; also, the impossibility of blow-through, into the open, will permit this without risk of waste. Finally, the real discharge force is full coil pressure in the receiver and no pressure in the return trap chamber. With practically all non-return trap coil equipment there is restriction in the drain at *d*, Fig. 6; also, instead of free swing check valves as there shown at *C*, there is some form of adjustable check with the indirect opening common to the globe form of valve. Such restrictions of flow are primarily for the prevention of wasteful blow-through. To this is added the very usual high back pressure in the carry-away condensation main of the usual multiple non-return vacuum pan equipment.

Some analysis of the simplest application of one return steam trap to one vacuum pan having been given, succeeding papers will illustrate and describe the details of piping requirement, cycle of return trap movement, and its application to other service than boiler feeding.

(To be continued.)

Data concerning the Advantages, Production, and Cost of "Natilite" Motor Fuel.

IV.

A MODERN "NATILITE" PLANT.

In the preceding articles on this subject, we have dealt in a general way *inter alia* with the "permanent world famine" in petrol¹; with the advantages of a mixture of alcohol and ether ("Natilite") as motor fuel²; with the feasibility of the erection of "centrals" for the production of "Natilite" in cane growing locations³; with the raw material that may supplement the molasses supply⁴; and

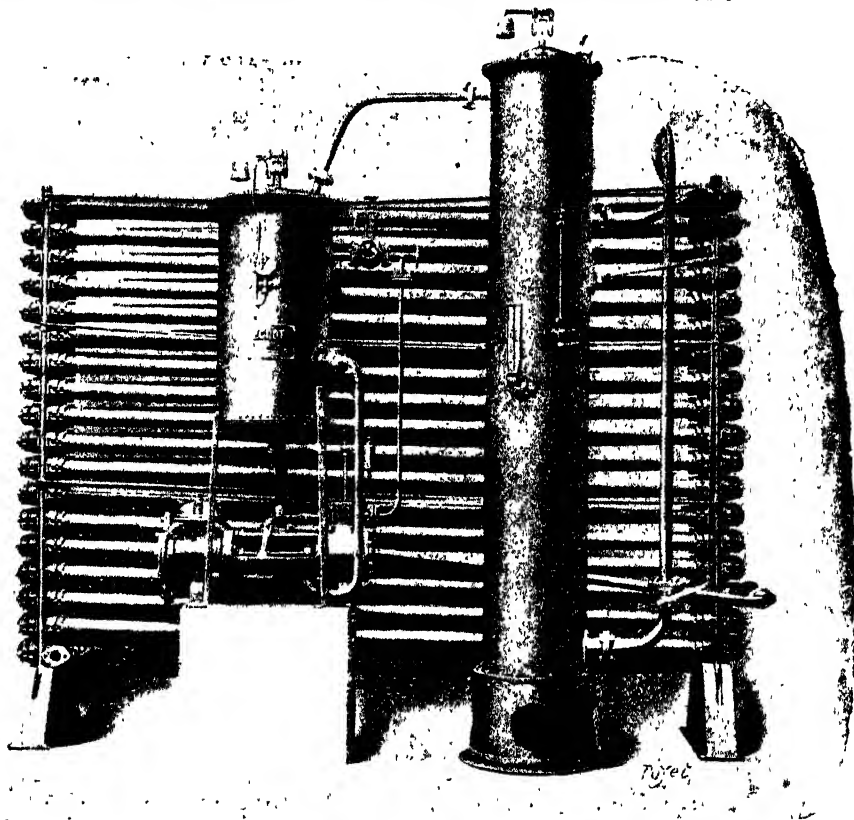


FIG. 1.

also with the de-naturing of alcohol when used for the purpose of motor fuel.⁵ It is now of much interest to give a brief description of a modern "Natilite" plant, which is conducted with great efficiency in respect both of fermentation and distillation. It is located at Merebank, about eight miles from Durban, Natal.

In this factory the only saccharine raw material used is molasses, which is brought from the mills producing it in "treacle tank trucks," and stored in a large reservoir constructed in masonry covered with a suitable roofing. About 45

¹ *I S.J.*, 1921, 147-148. ² *Ibid.*, 1921, 148-149. ³ *Ibid.*, 1921, 213. ⁴ *Ibid.*, 1921, 214.

⁵ *Ibid.*, 1921, 266-268.

Data concerning the Advantages, etc., of "Natilite" Motor Fuel.

tons of molasses are fermented in 24 hours. It is pumped from the reservoir to the factory into the diluting tanks, where it is mixed partly with cold water and partly with cold spent wash or vinasse, agitation being effected by means of compressed air. A wort at about 12°Bé. (that is, 1091 sp. gr.) at as low a temperature as possible is thus obtained, and it is allowed to run into the several fermentation tanks after the propagation of the pure yeast.

STERILIZATION AND THE USE OF PURE YEAST.

Fermentation in the modern industrial alcohol factory, in which a product of high yield and high purity is sought, must be conducted under very different conditions from those that obtain in the ordinary rum factory in the West Indies, in which the object in view is the production of a spirit of special flavour, the yield being generally speaking a secondary consideration. In order to realize the

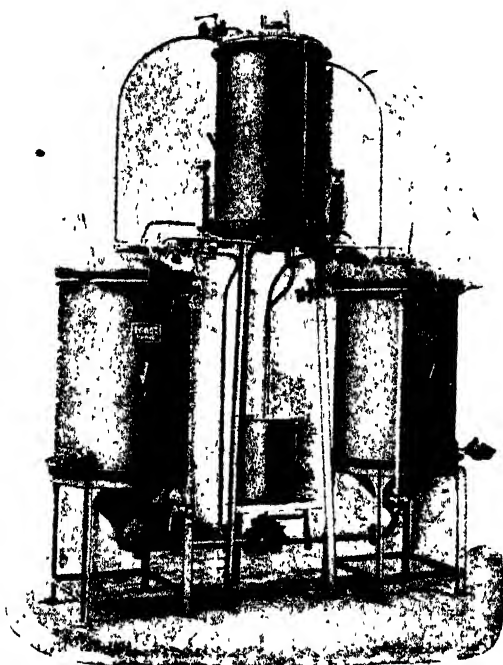


FIG. 2.

highest yield possible of pure alcohol, pure yeast cultures under aseptic conditions must be employed, a point which has already been mentioned¹; and in the "Natilite" factory this is done in a certain and automatic manner by means of the apparatus depicted in Figs. 1 and 2. Some of the wash going into the fermentation tanks is intercepted and sterilized, in order to destroy the bacteria, foreign yeasts and other micro-organisms present, which if permitted to propagate would undoubtedly lead to the formation of a certain amount of by-products, and thus decrease both the yield and quality of the alcohol. A special sterilizer,² which functions automatically and definitely, and controls both the temperature and time of heating, is used. As one may see on reference to Fig. 1, it consists of three parts: (1) the system of tubes, in which the wort entering is heated by means of

¹ *Ibid.*, 1921, 215.

² Manufactured by EGROT & GRANGE, of Paris, and termed by them the *Stérilisateur-Récupérateur-Réfrigérant*.

the sterilized wort leaving, another series of tubes completing the cooling effect; (2) the pump for circulating the wort through the tubes, the exhaust steam from which is used for sterilizing; and (3) the sterilizing vat, in which the wort is raised to the temperature chosen, and maintained at this degree, its discharge being effected by means of a suitable regulating device. This sterilizing apparatus besides being automatic works very economically from the point of view of cost of fuel, owing to the method of heat exchange which is adopted.

Having sterilized a sufficient quantity of the wort, it is now possible to proceed with the propagation of the pure culture of yeast (supplied by a bacteriological laboratory in Europe), the apparatus shown in Fig. 2 being used for this purpose. In this particular "Natilite" factory, however, the upper vessel is not included in the yeast apparatus, since it is a sterilizer, used only when the special automatic sterilizer just described has not been installed. There are, therefore, two vessels, each of about 110 gallons capacity, which preliminarily are sterilized by means of steam. In each are placed 25 gallons of the sterilized wort, preferably at 30°C. (86°F.); and then the pure yeast is added through a tubulure in the cover.

Fermentation develops rapidly, as one may observe by the liberation of gas through a small tube dipping into an antiseptic solution contained in a small recipient. After a suitable interval of time, a fresh quantity of sterilized wort is added to that already in fermentation; and later yet another, until the vessels are nearly full. Soon this mixture of wort and yeast is in full fermentation, and some can then be sent to the yeast vats, the volume of liquid thus abstracted being replaced by fresh sterilized wort.

These yeast vats are four in number, and each hold about 1000 gallons. First some of the sterilized wort is sent into them; then some of the fermenting wort from the pure yeast apparatus, more sterilized wort being subsequently added from time to time until they are full. Fermentation is allowed to proceed for a certain time, at the end of which the cells of the micro-organism have become very numerous, and the yeast is ready to be used in the fermentation vats.

There are ten of these fermentation vats, the capacity of each being 10,000 gallons. In filling them a certain quantity of the ordinary unsterilized wort (that is, the mixture of diluted molasses and spent wash or vinasse) is added; then some of the fermenting wort from the yeast vats. A vigorous and healthy fermentation results; and after a little time more wort may be added to this *pie de cuve*, feeding being continued till the vat is full. The wort will then have a density of about 6-7° Bé. (that is, 1045-1050 sp. gr.), and about 24 hours later the fermentation will be finished. These fermentation vats are provided with cooling coils to prevent any undue increase of temperature, which might adversely affect the yield. It should also be added that when operating in this way neither the pure yeast culture vessels, nor the yeast vats are emptied entirely. In each there is always left a sufficient quantity of the fermenting wort so as to start the fermentation of the succeeding addition of sterilized wort. It is unnecessary to renew the original pure yeast culture before the lapse of several weeks. This particular operation of renewing the original culture is therefore reduced to a minimum, and the ordinary routine can be entrusted to any careful workman. This method of fermentation by pure yeast not only assures rapidity of work, and an almost complete conversion of the fermentable sugars into alcohol, but enables one to obtain a wash of high alcoholic content (about 8 per cent.), an advantage that results in a considerable economy of fuel in the distillation. The fermented wash is pumped to the still supply tanks, which are placed in a lofty position in the distillation house of the factory.

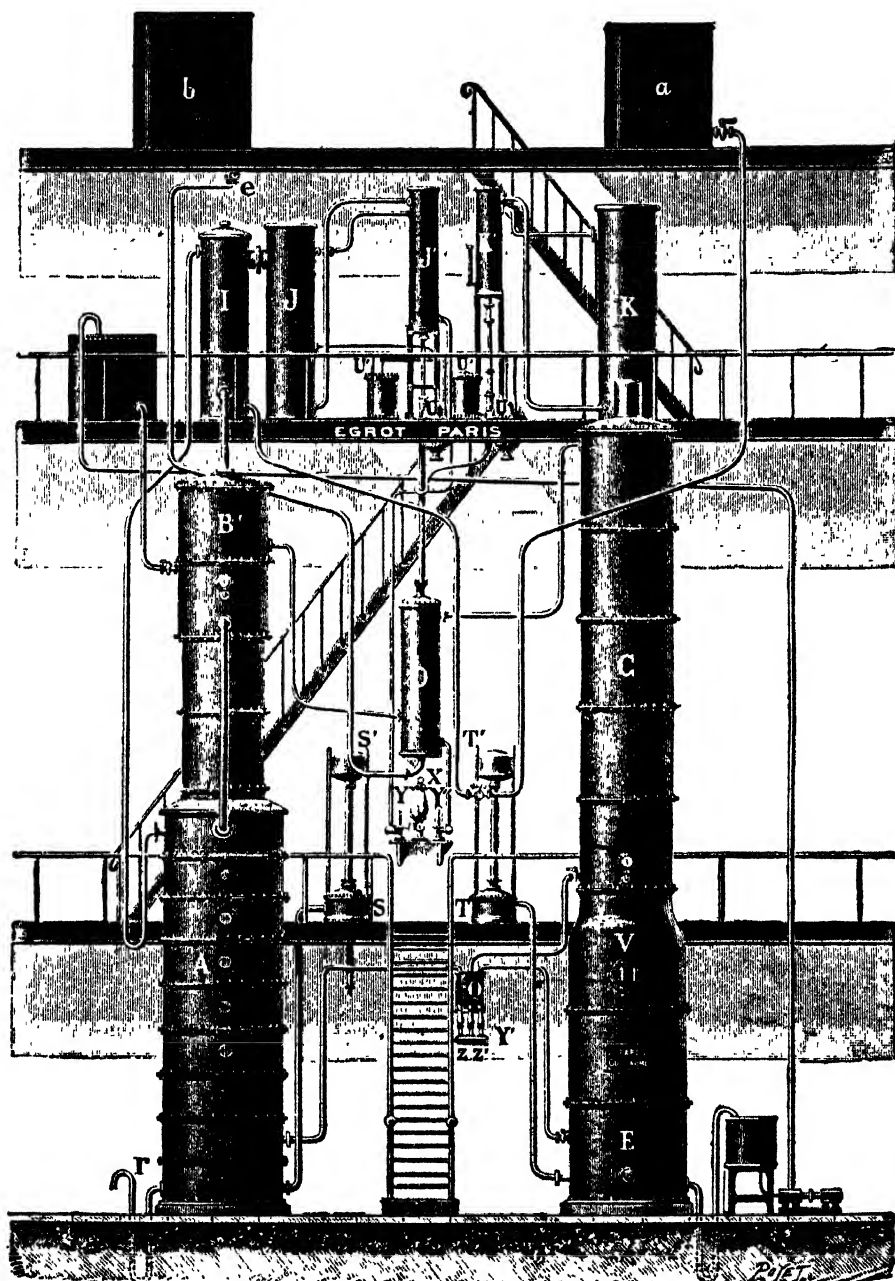


FIG. 3.

DISTILLATION AND RECTIFICATION.

We now come to consider the important matter of the distillation and rectification of this fermented wash in a plant which may be regarded as one of the most modern and most efficient of its kind. It may be pointed out here that the spirit used for "Natilite" should have a certain high degree of purity, firstly because some of the possible impurities, such as aldehydes, may act corrosively on the metal parts of the motor, and secondly because the preparation of the ether demands a pure alcohol. Moreover, a "Natilite" factory may find it advantageous to sell a certain proportion of its production to manufacturers of pharmaceutical products, essences, scents, and the like, thus probably securing an additional lucrative market, though this would naturally depend upon the conditions of the country entered.

Although the method of fermentation outlined above reduces the quantity of impurities to a minimum, yet some are always formed. Among the volatile impurities that are inevitably produced are some aldehydes and ethers, and some fusel oil (chiefly higher alcohols, as propyl, isobutyl, and amyl); and it is the purpose of distillation and rectification to separate the ethyl alcohol from these by-products so as to obtain a pure and concentrated spirit. Ordinary direct distillation without fractionation (as every chemist knows) is incapable of separating the impurities under consideration in anything like an efficient manner, and up to the end of last century the purification was conducted in two separate operations: (1) distillation proper for the purpose of obtaining a concentrated spirit though still containing the impurities; and (2) rectification, which effected the separation of these impurities.

Rectification was formerly carried out discontinuously, that is to say, in several different stages, so that the more volatile products (the aldehydes and ethers), then the alcohol proper, and lastly the less volatile bodies (the fusel oil) came over in succession. But the separation was not a sharp one, each fraction being more or less contaminated with one or other of the impurities to a greater or less extent, the result being a relatively low yield of rectified alcohol not always of a great degree of purity. Now, however, marked improvements in this branch of technology make it possible to carry out the distillation *continuously in one operation* with a high yield of very pure alcohol.

In the case of the "Natilite" factory under consideration, the distilling and rectifying plant is that known as the E. GUILLAUME system Type A.¹ It is capable of producing 3000 gallons of 96 per cent. (by vol.) alcohol in 24 hours, and its general design is shown in Fig. 3.

Referring to this illustration, the fermented wash to be distilled, which is contained in the storage tank *a*, is first passed through the wash-heater *I* where its temperature is raised by the condensation of alcohol vapours produced at a little later stage of the process. It then runs into the distillation column *A*, in which it falls through a series of plates² (Fig. 4), coming there into contact with an ascending current of steam admitted by way of the regulator *S*. Volatilization of the spirituous constituents thus occurs, and the alcoholic vapours on leaving the column *A* reach the purifying column *B*, *B'*, which is also equipped with the special plates mentioned. In this apparatus, the more volatile impurities (the aldehydes and ethers) are concentrated in the upper part *B'*, from which they pass successively into the wash-heater *I* and the condensers *J* and *J'*, being finally withdrawn by way of the test-glass *Y*.

¹ Constructed by Messrs. EGROT & GRANGÉ, of Paris.

² EGROT design.

Returning again to the column *B*, the vapour of the alcohol proper is drawn off, and is transferred to the column *E* situated at the foot of the rectifying apparatus, steam being admitted from the regulator *T*, so as to drive the vapours upwards through the superimposed plates to the upper rectifying column *C*. At the lower part of this column, the extraction of the amylic and propylic impurities is effected. Lastly, the alcoholic vapour, now concentrated to 96 per cent., is condensed in cooler *O*, being drawn off through the test-glass *X*.

It is of importance to observe the rather remarkable degree of efficiency of such a system of distillation and rectification. A recovery of alcohol (96° G.L. strength) amounting to about 90 per cent. of that originally in the fermented wash is realized, the impurities separated being the aldehydes and ethers, 3-4 per cent.; the intermediate products, 3 per cent.; and the amylic and propylic products, also about 3 per cent. In the "Natilite" factory now being described, 2750 gallons of alcohol in 24 hours, plus about 300 gallons of alcohol suitable for de-naturing and about 8 gallons of fusel oil, are obtained.

PREPARATION OF THE ETHER.

It remains briefly to describe the manufacture of the ether with which the alcohol is mixed to form "Natilite." Ether is quite easily obtained by dehydrating

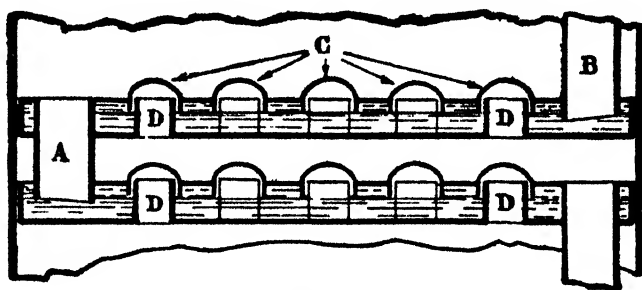
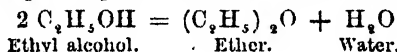


FIG. 4.

alcohol with concentrated sulphuric acid, and the chemical reaction that occurs may be expressed by the following equation (though actually it occurs in two stages with ethyl hydrogen sulphate as the intermediate body):



In the "Natilite" factory under consideration, the Annaratone continuous and automatic system of ether production¹ is installed, the possible production being 3000 gallons in 24 hours. From the storage tank the 96 per cent. alcohol is pumped up to another tank from which it flows into a so-called superheater, a vessel heated by steam at 40 lbs. pressure per sq. in. It is volatilized in this vessel by passing through a copper coil. This alcohol vapour now enters the bottom of the "etherifier," a cylindrical lead-lined heating pan, which contains a number of balls over which sulphuric acid is allowed to drop slowly, a large surface of liquid thus being exposed. Transformation to ether occurs instantaneously, the alcohol being in contact with the acid only momentarily, and the ether vapour passes to a so-called saturator or washer, in which it is met by a solution of caustic soda circulating in the contrary direction. Thus neutralized, the vapours enter a rectifying column in which the unconverted alcohol vapour is condensed, withdrawn, and condensed, while the ether passes from the top of the apparatus to the cooler.

¹ French patent, 408,089.

About 3 lbs. of acid and 14 lbs. of soda are required for every 100 lbs. of ether made. Lastly, the alcohol and ether in the proportions specified in the "Natilite" patents,¹ together with the ammonia and denaturing agent, are mixed together in a simple apparatus, and filled into containers ready for the market. The general design of the ether and mixing plant is shown in Fig. 5.

In the operation of the "Natilite" plant here described, it is of importance for all interested to note the small amount of labour that is demanded, namely the following workmen per shift: one man and assistant for preparing the wort

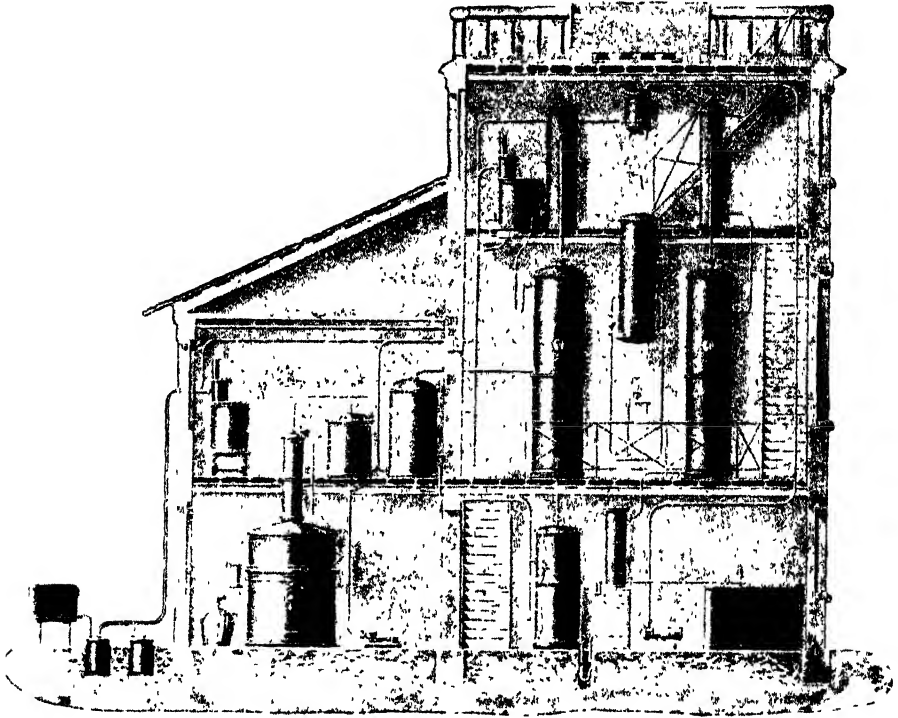


FIG. 5.

and operating the fermentation; one man and assistant for the distilling and rectifying apparatus, and the ether plant; two men on the boilers; and finally one man to look after the engines and pumps.

This "Natilite" plant has given every satisfaction to the principals concerned. It has operated smoothly, and has given good yields at a reasonably low cost. Its success demonstrates the practicability of the production of "Natilite" in every tropical country; and these four articles which we have published would appear to have shown without doubt the great future that may be expected for the motor fuel known as "Natilite."

(Concluded.)

In New Zealand a plant is being established to distil alcohol from the juices of flax, which contains fermentable sugars. It is anticipated that about 40,000 gallons of 96 per cent. alcohol will be produced during the first year of operation, but the quantity expected to be produced later by this subsidiary of flax milling is about 200,000 gallons per annum.

¹ I.S.J., 1921, 150.

The 1920 Java Sugar Crop.

By H. C. PRINSEN GEERLIGS, Ph.D.

During the 1920 season, 183 sugar factories worked in Java, the total area of cane land planted and harvested being 156,069 hectares, or 385,647 acres. This area produced 236,858,100 piculs or 14,398,238 tons of cane, from which material 24,998,263 piculs or 1,519,606 tons of sugar were extracted.

Four factories, viz., those of Krebet, Kenongo, Karaanganom, and Gondanglipoero, idle in 1919 owing to adverse circumstances, were again active in 1920. Kebonardjo and Tjidahoe, which had worked in 1918, did not either in 1919 or in 1920; while cane planted by the Papoh estate has, in the year under review, again been crushed in the Garoem mill.

Owing to the better prospects of the 1920 crop, much more land was planted for that season, the acreage for which now equals that of 1916.

Particulars regarding the number of factories, planted area, amount of cane, both absolute and per unit of surface, as well as the figures for the sugar production, etc., are collected in the tables here given; and have been calculated from the data given by Mr. W. C. DICKHOFF in the *Archief voor de Suiker Industrie in Nederlandsch-Indie*.

The 1920 crop developed under not very favourable conditions in respect to the weather, which was too dry in October and November. It started late, but could be finished without hindrance, although the extremists had threatened general strikes and burnings of cane fields if the manufacturers would not comply with the rather far-reaching exigencies stated by revolutionary-minded labour leaders. Apart from one or two lengthy strikes, which held up work for several weeks on single factories, the grinding went on without much interruption due to labour questions, so that the season ended at the ordinary time.

Residencies and Totals.	Number of Factories in Operation.	I.—CANE CROP.		Cane Harvested.		
		Land under Cane.				
		Hectares.	Acres.	Tons. ¹	Tons per acre.	Kilograms per hectare.
Cheribon	12 ..	9,414 ..	23,262 ..	808,396 ..	34.73 ..	87,205
Pekalongan	18 ..	16,203 ..	40,038 ..	1,544,380 ..	38.58 ..	96,865
Banjoemas and Kedoe ..	8 ..	8,688 ..	21,468 ..	880,136 ..	41.01 ..	102,957
Djokdjakarta	17 ..	13,620 ..	33,655 ..	1,419,271 ..	42.15 ..	105,829
Serakarta	16 ..	12,827 ..	31,696 ..	1,222,181 ..	38.55 ..	96,778
Semarang	12 ..	9,597 ..	23,714 ..	906,045 ..	38.20 ..	95,908
Madison	6 ..	6,583 ..	16,267 ..	555,581 ..	34.14 ..	85,725
Kediri	21 ..	21,537 ..	53,218 ..	1,924,744 ..	36.16 ..	90,773
Soerabaja	36 ..	26,982 ..	66,672 ..	2,301,102 ..	34.53 ..	86,683
Paseroean	29 ..	24,022 ..	59,368 ..	2,145,620 ..	36.16 ..	90,773
Besoeki	9 ..	6,596 ..	16,299 ..	690,782 ..	42.39 ..	106,438
Total, 1920	183 ..	156,069 ..	385,647 ..	14,398,238 ..	37.34 ..	93,732
„ 1919	179 ..	137,655 ..	340,138 ..	13,075,138 ..	38.10 ..	96,517
„ 1918	186 ..	163,071 ..	402,943 ..	15,637,342 ..	68.44 ..	97,387
„ 1917	155 ..	160,439 ..	396,440 ..	17,079,303 ..	43.09 ..	108,179
„ 1916	186 ..	155,165 ..	385,290 ..	15,878,300 ..	41.11 ..	103,218
„ 1915	186 ..	151,165 ..	373,500 ..	14,189,000 ..	37.99 ..	96,385
„ 1914	188 ..	147,465 ..	366,000 ..	14,901,000 ..	40.87 ..	102,009
„ 1913	190 ..	145,321 ..	359,200 ..	14,951,300 ..	41.63 ..	104,534
„ 1912	184 ..	140,303 ..	346,800 ..	14,374,300 ..	41.53 ..	104,263
„ 1911	185 ..	135,780 ..	335,600 ..	14,068,900 ..	41.94 ..	105,307

¹ Tons of 2240 lbs.

II.—SUGAR EXTRACTED.

Residencies and Averages	Kilograms per hectare	Lbs. per acre.	On 100 Cane.	Yearly maximum molasses output of any single factory.	
				Kilograms per hectare.	Lbs. per acre.
Cheribon	8,940 ..	8,206 ..	10-25 ..	10,687 ..	9,549 ..
Pekalongan	9,955 ..	8,935 ..	10-28 ..	12,097 ..	10,792 ..
Banjoemas and Kedoe .. .	10,601 ..	9,458 ..	10-30 ..	13,159 ..	11,733 ..
Djokdjakarta	12,331 ..	11,002 ..	11-65 ..	15,178 ..	13,540 ..
Soerakarta	11,435 ..	10,202 ..	11-81 ..	13,220 ..	11,801 ..
Semarang	10,263 ..	9,162 ..	10-70 ..	12,253 ..	10,931 ..
Madioen	9,074 ..	8,090 ..	10-68 ..	— ..	— ..
Kediri	9,593 ..	8,539 ..	10-57 ..	12,489 ..	11,129 ..
Soerabaja	8,956 ..	8,000 ..	10-33 ..	13,150 ..	11,724 ..
Paseroean	9,052 ..	8,075 ..	9-97 ..	12,071 ..	10,774 ..
Besoeki	10,261 ..	9,163 ..	9-65 ..	12,985 ..	11,583 ..
Average, 1920	9,892 ..	8,826 ..	10-55 ..	15,178 ..	13,540 ..
„ 1919	9,706 ..	8,657 ..	10-06 ..	14,639 ..	13,057 ..
„ 1918	10,904 ..	9,723 ..	11-19 ..	15,996 ..	14,265 ..
„ 1917	11,382 ..	10,117 ..	10-50 ..	16,415 ..	14,696 ..
„ 1916	10,355 ..	9,238 ..	10-03 ..	15,300 ..	13,660 ..
„ 1915	8,729 ..	7,788 ..	9-16 ..	12,941 ..	11,546 ..
„ 1914	9,526 ..	8,495 ..	9-28 ..	14,125 ..	12,602 ..
„ 1913	10,087 ..	9,110 ..	9-65 ..	14,708 ..	13,122 ..
„ 1912	10,026 ..	8,910 ..	9-63 ..	13,490 ..	12,034 ..
„ 1911	10,805 ..	9,617 ..	10-26 ..	15,091 ..	13,460 ..

III.—SUGAR PRODUCTION IN TONS.¹

Residencies and Totals.	First Sugars.	Centrifugalled After- products.	Sack Sugar.	Total Production; Afterproducts 4:3:1	
				Sack Sugar	Solidified Molasses.
Cheribon	80,012 ..	3,535 ..	353 ..	82,789 ..	8,426 ..
Pekalongan	154,001 ..	6,251 ..	168 ..	158,773 ..	19,515 ..
Banjoemas and Kedoe .. .	90,456 ..	190 ..	73 ..	90,684 ..	9,335 ..
Djokdjakarta	164,006 ..	1,630 ..	161 ..	165,308 ..	1,154 ..
Soerakarta	141,492 ..	3,790 ..	34 ..	144,349 ..	4,069 ..
Semarang	95,216 ..	2,293 ..	24 ..	96,948 ..	13,108 ..
Madioen	58,454 ..	426 ..	32 ..	58,790 ..	7,441 ..
Kediri	202,271 ..	1,454 ..	6 ..	203,365 ..	26,881 ..
Soerabaja	234,341 ..	4,474 ..	182 ..	237,789 ..	28,907 ..
Paseroean	211,921 ..	2,617 ..	252 ..	214,017 ..	28,843 ..
Besoeki	65,078 ..	2,094 ..	21 ..	66,650 ..	16,780 ..
Total, 1920	1,497,244 ..	28,754 ..	1,306 ..	1,519,562 ..	164,459 ..
„ 1919	1,297,320 ..	22,324 ..	1,653 ..	1,315,158 ..	96,303 ..
„ 1918	1,714,833 ..	45,292 ..	2,700 ..	1,750,197 ..	18,511 ..
„ 1917	1,779,654 ..	18,708 ..	3,976 ..	1,793,415 ..	49,870 ..
„ 1916	1,579,670 ..	27,736 ..	4,564 ..	1,604,154 ..	85,749 ..
„ 1915	1,273,190 ..	28,977 ..	6,335 ..	1,298,307 ..	127,543 ..
„ 1914	1,305,246 ..	91,547 ..	8,614 ..	1,382,825 ..	94,765 ..
„ 1913	1,381,673 ..	112,838 ..	13,164 ..	1,442,884 ..	65,756 ..
„ 1912	1,338,607 ..	50,362 ..	11,324 ..	1,384,242 ..	75,510 ..
„ 1911	1,403,642 ..	43,799 ..	14,047 ..	1,443,465 ..	58,288 ..

¹ Tons of 2240 lbs.

The 1920 Java Sugar Crop.

IV.—SUBDIVISION OF THE CROP IN PERCENTAGE ACCORDING TO ASSORTMENTS.

Residencies and Averages.	White plan- ta- tion sugar: first runnings.	White plan- ta- tion sugar: second runnings.	Channel assort- ment refining crystals, 98° pol.	Refining crystals, 98.5° pol.	Second bollings.	Molasses sugar.	Centri- fugalled last product.	Sack sugar.	Total.
Cheribon	45.6	2.9	28.5	18.6	..	4.0	0.2	0.3	100
Pekalongan .. .	64.0	2.6	15.1	14.3	..	3.9	..	0.1	100
Banjoemas and Kedoe ..	..	..	83.1	16.6	..	0.2	..	0.1	100
Djokdjakarta .. .	75.1	0.7	18.1	5.1	..	0.6	0.2	0.2	100
Soerakarta .. .	86.8	0.8	9.9	2.4	..	0.1	..	..	100
Semarang .. .	47.9	2.4	29.3	18.0	..	0.8	1.5	0.1	100
Madjoen .. .	82.9	0.9	15.4	..	..	0.8	..	..	100
Kediri .. .	65.5	0.1	30.3	13.4	..	0.7	..	..	100
Soerabaja .. .	59.1	0.1	21.6	17.2	..	1.9	0.1	..	100
Paseroean .. .	22.6	..	47.1	29.1	..	1.0	0.1	0.1	100
Besoeki .. .	..	..	66.5	30.3	..	2.6	0.5	0.1	100
Average, 1920 .. .	51.71	0.83	30.41	15.08	..	1.07	0.21	0.09	100
„ 1919 .. .	49.7	2.1	23.1	23.3	..	1.2	0.5	0.1	100
„ 1918 .. .	45.9	3.2	27.0	21.0	0.1	2.4	0.2	0.2	100
„ 1917 .. .	50.3	1.9	40.6	6.2	..	0.7	0.1	0.2	100
„ 1916 .. .	48.1	2.9	37.3	9.7	..	1.4	0.2	0.3	100
„ 1915 .. .	43.6	4.2	34.9	14.1	0.3	1.7	0.5	0.5	100
„ 1914 .. .	40.3	4.0	32.3	15.7	0.1	5.8	1.1	0.7	100
„ 1913 .. .	32.9	6.8	30.0	20.9	0.8	6.4	1.3	0.9	100
„ 1912 .. .	33.6	5.6	29.9	26.2	0.1	2.4	1.4	2.8	100
„ 1911 .. .	35.2	0.2	33.4	27.1	..	1.7	0.2	2.2	100

The cane planted was originally almost exclusively from canes raised from seed a few years ago; only 1 per cent. of the whole crop consisted of the old Cheribon cane, which still maintains a modest place in the list. The E.K. 28, which made its appearance in the statistics in 1917, now occupies about one-third of the whole area; on the other hand, B. 247, which was planted to the extent of 58 per cent. of the total in 1914, has now dropped down to 26 per cent. It appears therefore that planters are constantly on the look-out for the best varieties.

The cane production over the whole island amounted to 37.34 tons to the acre, or again less than in 1919. This yield is rather poor, and no other instance of so low a figure can be found among the averages in our present statistics. The residency of Besoeki, in previous years among the lowest on the list, was at the head with 42.39 tons, followed by the residencies of Djokdjakarta and Soerakarta,

V.—PERCENTUAL COMPOSITION OF THE CANE PLANTINGS FOR THE CROP OF—

VARIETY.	1913	1914	1915	1916	1917	1918	1919	1920
B. 247 .. .	54	58	57	54	48	41	29	26
P.O.J. 100 .. .	32	29	30	30	31	28	16	10
Cheribon .. .	8	6	5	5	4	3	1	1
P.O.J. 213 .. .	1	1	1	1	1	..	..	..
E.K. 2 .. .	..	1	1	2	4	4	6	6
E.K. 28 .. .	..	..	..	..	2	6	23	32
F. 90 .. .	..	..	..	1	2	4	4	3
D.I. 52 .. .	..	..	..	..	1	4	13	14
Tjep. 24 .. .	..	..	..	..	..	2	1	1
S.W. 3 .. .	..	..	..	..	..	1	1	2
Various .. .	5	5	6	7	7	6	6	5
Total .. .	100	100	100	100	100	100	100	100

where usually the highest tonnage is obtained, and where now 42.15 and 38.55 tons per acre were obtained. The residency of Banjoemas also showed a good result with 41.01. It appears that those places which are best favoured with irrigation water or with much rain, produced most in the year under consideration.

The percentage of sugar extracted from the cane was rather good, being 10.55 per cent., or about 0.5 per cent. more than in the year immediately preceding. The highest rendement is reported from Soerakarta with 11.81 per cent., and the lowest from Besoeki with only 9.65. This rather satisfactory rendement does make good the low tonnage, since the average sugar production to the acre was no more than 8.826 lbs. of sugar, or only slightly more than in 1919. The highest average yield is reported from Djokdjakarta with 11,002 lbs., and the lowest from Soerabaja with only 8000. Notwithstanding the generally lower output over the whole island, the maximum yield of sugar per acre made by one single factory is better now, being 13,540 lbs. against 13,057 a year ago.

The total amount of sugar obtained in the factories was 1,519,562 tons, of which about one-half was white sugar, fit for human use without having to pass through any refining process. The percentage of grey refining sugar was much higher than a year ago, to the detriment of the brown refining sugar. The general standard of sugar turned out in 1920 was a high one with an insignificant amount of after-products.

The better steamship communication with British India caused the exportation of solidified molasses to be taken up to such an extent that in the year under consideration no less than 164,459 tons of that article were produced, or the highest amount on record.

The table given below has been calculated from the figures issued by the Chemical Department of the Java Sugar Experiment Station. The following observations may be derived from them.

The figures cover the results of 136 sugar factories and therefore the data relating to sucrose content of cane, etc., do not coincide with the ones given before, which bear on all the 186 estates.

The sucrose content of the cane was very satisfactory, and in the years reviewed here was only surpassed in 1918. The maximum figure is reported from Pohdjedjer with 15.34 per cent. and the minimum from Soekowidi with 10.50.

The fibre in cane is about the same as during the last five years, which shows that the cane varieties in use remain the same in this respect, whereas formerly the highly fibrous ones came more to the front. Balangbendo shows the highest fibre, viz: 17.81 per cent., and Pangoengredjo the lowest with 10.52.

The sucrose on 100 of bagasse is only slightly higher than in last year, when the sucrose content of the cane was so much the lower. We find the maximum figure reported from Sedajoe with 7.77 per cent. and the minimum from Dinoyo with 2.61.

The moisture in bagasse is very low and in fact much lower than in the immediately preceding years, but the same as 10 years ago. The maximum comes from Pagongan with 50.92 per cent., the minimum from Alkmaar with 41.87.

Since the sucrose content of the cane is higher than in 1919, the amount of fibre the same and the loss of sucrose on 100 bagasse only slightly higher, the general sugar extraction has been better than before, viz., 92.5 on 100 parts of sugar in the cane. So far it is the highest average, and 0.2 better than in the former record year 1917.

The 1920 Java Sugar Crop.

The figure for the *sucrose lost in bagasse for 100 of cane* stands in direct connexion with the one given above. In 1920 it averaged 0·97 per cent., or the lowest on record since 1915. This is the more favourable, as in 1915 the sucrose content of the cane was not particularly high, which facilitated the production of a low-grade bagasse. Generally speaking, one can say that in 1920 the milling work and the juice extraction have been satisfactory, although a total loss of sugar during extraction of 7·50 per cent. is high enough, if one compares it with the brilliant results achieved in the Hawaiian Islands in milling.

The *sucrose on 100 of filter-cakes* was low, and amounted to 3·75 as an average, subdivided into 5·23 for factories using ordinary defecation, 5·51 for those using sulphitation, and 0·83 for those clarifying by the carbonatation process.

Among the factories clarifying by defecation and sulphitation the maximum sucrose content of the cake was 12·09 per cent. at Langsee, and the minimum 0·41 at Ketanen. The maximum and minimum values for carbonatation were 2·17 at Wonopringgo, and 0·13 at Barongan.

Loss of sucrose in filter cake on 100 cane was on an average 0·10, specified for defecation 0·10, for sulphitation 0·12, and for carbonatation 0·05.

VI.—FACTORY RESULTS DURING THE LAST DECADE.

CANE—	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
Sucrose.. . . .	12·71..	12·35..	12·54..	11·91..	11·63..	12·42..	12·82..	13·63	12·38..	12·94
Fibre.. . . .	12·32..	12·17..	12·40..	12·61..	13·26..	13·11..	13·02..	12·99..	13·01..	12·98
BAGASSE—										
Sucrose	4·60	4·47..	4·45..	4·21..	4·11..	4·00..	4·10..	4·34..	4·03	4·07
Moisture	46·75..	46·52..	46·52	46·27..	46·64..	46·97..	46·82..	47·22..	47·01	46·78
Sugar extraction by mills..	90·6	90·8	90·8	90·4	91·9	91·1	92·3	92·1	92·0	92·5
Sucrose in filter-press cakes ..	7·30..	6·96..	7·00..	6·72..	7·97..	4·51..	4·15..	4·36	3·70..	3·75
Sucrose in juice on 100 cane ..	11·52	11·21	11·38..	10·77..	10·69..	11·32	11·83	12·55..	11·39..	11·97
Purity of raw juice	81·57	81·47	80·95	80·39	82·00	84·41	85·80	86·50	83·7	85·4
Purity of final molasses .. .	33·54	33·00	32·92..	32·70..	32·45	32·4	32·6	33·1	32·1	32·2
Calculated available sugar	11·00	10·44	10·33..	9·94..	10·00..	10·80	11·40	12·17..	10·60..	11·31
Sugar extracted on 100 cane ..	10·80	10·21..	10·00..	9·76..	9·65	10·42..	11·00..	11·68..	10·44..	11·13
SUCROSE TURNED OUT ON 100—										
Cane	10·38..	9·80..	9·75..	9·33..	9·18	10·06	10·48..	11·27..	10·12..	10·64
Sucrose in cane	81·67	79·35	77·75	78·74	79·20	81·00	81·75..	82·61..	81·66	82·23
Sucrose in juice	90·10..	87·42..	86·77	86·63	86·40	88·90..	88·58..	89·80..	88·85..	88·90
SUCROSE LOST ON 100—										
Cane	2·33..	2·55	2·79..	2·58..	2·45..	2·36..	2·34..	2·36..	2·36..	2·30
Sucrose in cane	18·33..	20·65..	22·25	21·66..	20·87..	19·00..	18·25..	17·39..	18·34..	17·77
Sucrose in juice	9·90..	12·58..	14·23..	13·37..	13·60..	11·10	11·42	10·20..	11·15..	11·10
IN BAGASSE ON 100—										
Cane	1·19..	1·14..	1·16..	1·14..	0·94..	1·10..	0·99..	1·08..	0·99..	0·97
Sucrose in cane	9·36..	9·23..	9·25..	9·57..	8·08..	8·86..	7·72..	7·92..	7·99..	7·50
IN FILTER CAKE ON 100—										
Cane	0·10..	0·10..	0·11..	0·13..	0·12	0·10..	0·09..	0·10..	0·09..	0·10
Sucrose in cane	0·79..	0·82..	0·86..	1·09..	1·03..	0·80..	0·74..	0·73..	0·73..	0·77
Sucrose in juice	0·87..	0·89..	0·98	1·21..	1·12..	0·88	0·80..	0·80..	0·79..	0·80
IN MOLASSES ON 100—										
Cane	0·96..	1·16..	1·22..	1·01..	1·09..	0·85..	0·91..	0·94..	0·90..	0·93
Sucrose in cane	7·55..	9·39..	9·73..	8·48..	9·38..	6·84..	7·11	6·95..	7·27..	7·11
Sucrose in juice	8·33..	10·35..	10·74..	9·35..	10·20..	7·59..	7·70..	7·50..	7·90..	7·80
UNACCOUNTED FOR ON 100—										
Cane	0·08..	0·15..	0·30..	0·30..	0·30..	0·36..	0·35..	0·24..	0·28..	0·30
Sucrose in cane	0·63..	1·21..	2·41..	2·52..	2·38..	2·50..	2·68..	2·17..	2·35..	2·39
Sucrose in juice	0·70..	1·32..	2·51..	2·81..	2·29..	2·66..	2·92	2·54..	2·46..	2·50

The larger bulk of filtermud in the carbonatation process makes up for its lower sucrose content, so that, after all, the average loss of sucrose in the filter-cake on 100 juice remains the same for every clarifying method.

The figure for the *quotient of purity of the cane juice* is rather high in the year under consideration, accompanying a high sugar content of the cane. It averaged 85.4, which in our table is only exceeded in the rich years of 1917 and 1918. Its maximum is reported from Pangoengredjo with 90.1, its minimum from Soekowidi with 78.2, while the sucrose content of the cane in those factories has been 15.11 and 10.50 per cent. respectively.

The *quotient of purity of the final molasses* is low and averages 32.2. Subdivided according to the clarification methods we find for defecation 32.1, for sulphitation 32.0, and for carbonatation 33.5. This is for the ratio between the polarization and the degrees Brix, but if we compare the ratio between the Clerget sucrose and the degrees Brix, we find for the general average 36.0, for the average defecation 36.2, for the average sulphitation 35.7, and for the average carbonatation 36.2. Now that the different methods of clarification have had their chance of being thoroughly studied, we see that the exhaustion of the molasses may be conducted to the same low level in every one of them. We find for the maximum ratio "polarization: Brix" 36.5 at Wonopringgo, and the minimum of 28.5 at Minggiran. For the ratio "sucrose: Brix" the maximum was at Pangoengredjo with 40.8 and the minimum at Gemoe with 32.0.

As a consequence of the high sucrose content of the cane, combined with a fair extraction and a satisfactory quotient of purity of the juice, the figure for the *calculated available sugar* is a high one. It was 11.30 on 100 of cane, another figure that was only exceeded in the favourable years of 1917 and 1918. As this figure stands in direct relation to the sucrose content of the cane, and the quotient of purity of the juice, and these two factors act in the same direction, it is not surprising that the factory of Pohdjedjer, which shows the maximum sucrose content in the cane, heads again the list here with 14.56 per cent. of available sugar, while Soekowidi is again last with only 8.36 per cent. The available sugar is expressed in raw sugar of 96.5° polarization and 0.7 per cent. moisture.

The *sugar actually extracted on 100 of cane* is also expressed in the same value of raw sugar. It approaches the calculated one very narrowly, and averages 11.13 per cent. or 98.4 per cent. of the calculated value. The average percentage is for the defecation factories 98.6, for those using sulphitation 97.8, and for those using carbonatation 99.1. These differences are small, so that the calculation of the available sugar holds good for every method of clarification of the juice. The maximum proportion between calculated and extracted sugar is 104.1 at Oemboel and the minimum 87.4 at Wonopringgo.

The *average loss of sucrose in molasses on 100 cane* is about 0.93 per cent., or about the same as the loss in the bagasse. This loss was 7.11 on 100 parts of sucrose in the cane and 7.80 on 100 parts of sucrose in the juice. The highest figure for loss of sucrose on 100 of cane was reported from Olean (1.40), and the lowest was 0.57 at Medari.

The unaccountable loss, caused by inversion, leaking, spilling, charring, theft, etc., in which all errors of sampling and analysis are also incorporated, was small; and amounted to 0.30 on 100 of cane, and 2.50 on 100 parts of sucrose in the juice.

The general impression of the figures is that the work has been well done and that a maximum of high-class sugar has been extracted from the juice.

The sales of the sugar from the 1920 crop had already begun on the 20th July, 1919, at prices of 32 guilders per picul for plantation whites; 31 guilders for raw sugar 98° polarization; and 30.50 for raw sugar 96.5 polarization. In December of that same year the price was raised to 33 guilders; and later on to 35 per picul

The 1920 Java Sugar Crop.

of white sugar. In the beginning of 1920 the Associated Java Sugar Producers had sold from the crop of that same year 7,867,850 piculs of whites, 1,114,090 piculs of grey, 2,841,665 piculs of brown refining crystals, and 108,820 piculs of soft white sugar, together 11,941,425 piculs of their part of the crop, being estimated at 22·5 million piculs. The whole Java sugar crop was estimated at 25 million, of which 90 per cent. was in the hands of the Association aforementioned. As the Government feared that sugar would rise in price so high that the native population could not afford to purchase it, the Association put at the disposal of the Government an amount of 1·5 million piculs of white sugar at the price of 32 guilders, with full freedom to take the sugar or leave it just as the official bodies might think fit. In January, 1920, the price of sugar in first hands rose to 36 guilders per picul and in February to 40. At the end of that month the Association had sold (excepting the Government option) 9,230,721 piculs of whites, 2,977,580 piculs of grey, 4,031,095 piculs of brown sugar, and 125,290 of soft white, together 16,364,686 piculs.

VII. SUGAR EXPORTS 1ST APRIL—31ST MARCH. LONG TONS.					
DESTINATION.	1916-17.	1917-18.	1918-19.	1919-20.	1920-21.
Netherlands	31,809 ..	— ..	— ..	21,283 ..	9,804 ..
Belgium	— ..	— ..	— ..	— ..	7,396 ..
United Kingdom ..	548,980 ..	317,955 ..	142,547 ..	119,528 ..	50,642 ..
France	69,592 ..	34,468 ..	55,536 ..	41,636 ..	10,013 ..
Switzerland	— ..	— ..	6,528 ..	— ..	— ..
Russia and Finland..	— ..	— ..	2,958 ..	1,414 ..	10,922 ..
Denmark	— ..	— ..	— ..	2,370 ..	— ..
Sweden	— ..	— ..	— ..	14,522 ..	27,807 ..
Norway	11,855 ..	19,780 ..	44,272 ..	50,152 ..	31,008 ..
Italy	20,724 ..	— ..	5,495 ..	45,956 ..	18,166 ..
Portugal	— ..	— ..	— ..	— ..	1,000 ..
Spain	— ..	— ..	— ..	6,919 ..	3,004 ..
Greece	— ..	11,793 ..	5,162 ..	8,239 ..	5,907 ..
Rumania	— ..	— ..	— ..	3,921 ..	3,070 ..
Turkey	— ..	— ..	— ..	23,321 ..	2,174 ..
Egypt	— ..	— ..	2,844 ..	— ..	— ..
Argentina	— ..	— ..	5,200 ..	— ..	— ..
Suez	11,918 ..	18,231 ..	28,870 ..	11,083 ..	11,843 ..
Port Said, f.o.	25,117 ..	12,205 ..	19,438 ..	56,041 ..	353,630 ..
United States	— ..	— ..	7,423 ..	— ..	237,162 ..
Vancouver	8,007 ..	3,514 ..	17,556 ..	2,953 ..	— ..
Singapore	60,212 ..	157,736 ..	163,230 ..	64,568 ..	41,450 ..
China	6,987 ..	2,314 ..	31,961 ..	3,525 ..	3,765 ..
Hong Kong	138,829 ..	163,654 ..	308,792 ..	184,422 ..	171,398 ..
Japan and Formosa ..	49,369 ..	90,802 ..	439,396 ..	272,187 ..	94,473 ..
British India	407,018 ..	336,736 ..	343,480 ..	336,000 ..	212,562 ..
Australia	25,292 ..	— ..	30,000 ..	82,718 ..	63,362 ..
Siam	16,138 ..	21,397 ..	3,612 ..	152 ..	644 ..
Other Countries ..	— ..	141 ..	100 ..	3,428 ..	2,386 ..
Total	1,427,848 ..	1,190,726 ..	1,664,801 ..	1,356,338 ..	1,373,587 ..

During March no sales took place; but when in the month of April a sugar famine was feared in the United States, operators bought Java sugar eagerly, so that at the end of that month the Association had completed sales up to 20 million piculs or 1·2 million tons. In April the price went up to 45 guilders, in May to 52 for whites, to 49 for greys, and to 47·50 for browns; while the whole crop of after-products was sold at 40 guilders per picul. At the end of June the Associated

1 picul = 135 lbs.; 1 guilder in gold parity = 1s. 8d.

Java Sugar Producers had cleared their entire crop and had nothing more to sell; but at second-hand the price leapt up to 60 guilders per picul or £4 3s. per cwt.

In October, the market broke, and although a body of holders tried to keep up the price at 45 guilders, it sank to 14 in December. In the meantime the Government had no use for the sugar they had bought; and did not require to take advantage of the option. So 1.3 million piculs were restored to the Association, which was able to sell them gradually at 20 guilders per picul.

The average price, at which the 1920 Java sugar crop has been sold is 33 guilders per picul, or £2 5s. 3d. per cwt. The total monetary value of the 1920 crop, packed in gunny bags and delivered at the buyers' doors, may be calculated at 870 million guilders or over 70 million pounds sterling. At the end of 1920 no sugar remained in the hands of the producers, but merchants were still disposing of some sugar, which, for by far the greater part, has been shipped before 1st April, 1921. The destination of the sugar exported may be seen from the list in Table VII, an average of 130,000 tons being annually consumed in the territory of the Dutch East Indies.

Colloid Chemistry in the Manufacture of Sugar.¹

By Dr. JAROSLAV DĚDEK.

Chemist, Sugar Experiment Station, Prague, Czecho-Slovakia.

Sugar manufacture as an industry producing a vegetable product deals mainly with emulsoids.² In regard to the origin of the colloids to be met with, two kinds may be differentiated: (1) Native, which are introduced with the beet; and (2) secondary, which are formed during working, either by modification of the native forms, or from crystalloids (as sugar).

Those colloids of the first kind play the greater rôle in diffusion, clarification and crystallization, and those of the latter in affination and decolorization. It may perhaps be said that the first are the colloids of the sugar factory, and the latter those of the refinery. As may be seen, the influence of colloid chemistry extends to all stages of sugar production.

The first stage of production, namely diffusion, is an eminently colloid process, both in the coagulation of the proteins on heating, and in the passage of the sugar through the walls of the plant cells (dialysis). If it is borne in mind that colloids also are capable of passing through membranes, though slowly, one will see that the proteins present in diffusion juice do not entirely originate from the broken cells. Andrlik's observation that a diffusion juice having a small percentage of protein is obtained by hot working in the battery, the colloids being thus completely precipitated, appears to be in harmony with this view. Certainly, the increased rapidity of dialysis at the higher temperature must also here play a part, which under certain conditions may have just the contrary result. The observation of the same author that relatively less "injurious nitrogen" and ash than sugar pass through—though in osmosis the opposite occurs—is probably to be explained by the existence of complex compounds of protein bodies and ash.

¹ Abridged translation from the *Zeitschrift für Zuckerindustrie der czechoslovakischen Republik*, 1921, 45, No. 37, 275-278.

² In two previous articles under the same heading, Dr. DĚDEK had dealt with colloid chemistry in a general way. In this one he ably reviews what is known of the subject as particularly applied to beet sugar manufacture. In the literature of the beet sugar industry, little has been written on the importance of studying the various operations in the light of colloid chemistry, and so far as we are aware this is the most complete contribution in this direction. DEER, ZERBAN, GERLIGS, PECK, NORRIS, and others have drawn attention to the colloidal nature of clarification in the cane industry.—ED., I.S.J.

Colloid Chemistry in the Manufacture of Sugar.

It must, however, be admitted that from the point of view of colloid chemistry the processes occurring in diffusion have not been sufficiently studied in order to be intelligible. Particularly the nature and amount of the colloid substances in the diffusion juice, and also in the thin and thick juices, and finally in the molasses, remain uninvestigated. Relatively, more attention has been given to the molasses, thanks to Andriks's work on its colloid colouring substances.

A year after the first work of GRAHAM, use was made of dialysis in sugar manufacture in the osmose process. After some early failures caused mostly by unsuitable parchment, osmosis had a wide use, and performed good service until later it had to be abandoned on commercial grounds.

The second stage in manufacture, including defecation and saturation, has, besides its chemical nature, long been recognized to possess a physical characteristic—called adsorption—to which, in the year 1890, K. C. NEUMANN¹ drew attention. The great surface of the calcium carbonate in its state of formation acts as an adsorbent. Although, according to recent (unpublished) work by STANEK, chemical purification plays a great rôle, especially in the removal of the injurious nitrogen, yet it would seem that the full effect is attained by adsorption, as experiments in cane sugar manufacture on clarification with kieselsguhr or powerful vegetable carbons have shown. Colloid chemistry is thus called upon to pass judgment upon different saturation processes, as those of PSENICKA² and MACAS.

PLAUSON recommends clarification by means of ultra-filtration, using his so-called "wire filter," by means of which it is possible to retain all the colloids of the diffusion juice.³ It appears, however, that the small capacity of the filter and the great pressure required hardly permit of economical work in the factory. So far as is known to me, the original patents of Count SCHWERIN, dealing with the electro-osmotic extraction of sugar from beet slices, were nowhere applied on the large scale. Much more promising are the experiments carried out during the past few years on electro-osmotic purification.⁴ Saturation juice is led between diaphragms through which, by means of the effect of an electric current, impurities as salts, colouring substances, and colloids pass, or by which they are retained. Particulars of this process have been withheld; but so much is known that it has been possible, using saturated juice, to produce in the laboratory a perfectly colourless liquid having a quotient of nearly 100°; and further, that it has been possible to boil it directly to a consumption sugar without any formation of molasses. Disadvantages of this process are the costly current, and especially the membranes, which, while able at first to hold back the sugar, soon become pervious, loss of sugar thus arising.

In the further stage of production of filtration, colloids are most unwelcome guests. Either they are not caught (as in the 1919 campaign of unhappy memory), or they obstruct the cloth forming a slime, the filter-presses thus becoming great ultra-filters, showing, however, a somewhat low efficiency at the maximum pressure of 5-8 atmospheres. During boiling, colloids are only of significance in so far as they are precipitated or are formed.

In crystallization, colloid chemistry is of much greater importance. The whole mechanism of graining; the influence of a previous filtration; the influence of traces of colloids playing a protective rôle; the influence of small amounts of alkali (lime) on the course of boiling (as in "dead strikes"), resembling the

¹ *Zettach. Zuckerind. Bohm.*, 1890-1, 13, 369.

² German Patent, 318,654; see also *I.S.J.*, 1920, 348.

³ U.K. Patent, 155,834; not yet published. ⁴ *I.S.J.*, 1920, 466, 593.

remarkable increase in viscosity caused by traces of alkali; and further, the influence and importance of re-boiling, which has been studied by CLAASSEN and recently by VON GINNEKEN,¹ and which diminishes the rate of crystallization so as finally altogether to hold it back—these are the most striking questions pressing for colloid-chemical study. Moreover, concentrated solutions of sugar exhibit the Tyndall effect, one of the characteristics of colloid solutions.

In centrifugalling, the harmful influence of froth formation has long been recognized. It is clear from what is now known that here the surface energy, combined with the movement of organic substances to the outer layers, possess great importance.

With affination we enter the domain of refining, which is quite full of colloid problems. That of decolorizing, now also being eagerly taken up in raw sugar manufacture, has resisted a final elucidation for more than 200 years. It may be emphasized that the exclusive influence of the carbon is not so certain as one may generally believe. It now appears that the other components of the bone skeleton may possess an important and essential part in decolorizing. The absolute belief in the action of carbon arises from the results obtained with decolorizing carbons of vegetable origin having only a small percentage of ash.

These carbons in combination with other purification processes are called upon to replace char at some future date. They consist essentially of wood carbon so prepared that their adsorbing, and especially their decolorizing, powers are enhanced. The principle of all the methods of manufacture depends on endeavouring to make the surface of the carbon as great as possible, and ZERBAN,² of the Louisiana Experiment Station, has succeeded in establishing the conditions of working under which an increased decolorizing power may be expected.

An important matter is the condition of the carbon for filtration. There are excellent decolorizing carbons, which, however, are so fine or are of such a structure that the *clairce* cannot be filtered, or only so with great difficulty. Finally, there is the revivification of the carbon. One may have a relatively badly adsorbing carbon capable of being well and easily revived, which must be pronounced better than a good decolorizing preparation incapable of revivification, or one the regeneration of which is attended with great difficulty or heavy cost. The difficulties of regeneration are often not inconsiderable, as the toilsome experiments with "Carboraffin" have shown.³

The Government arrack distillery at Kalutara, Ceylon, has an annual output of 70,000 to 80,000 gallons, Indian or Javan molasses being mostly used as the raw material. A large number of primitive native distilleries supply the rest of the demands of the Colony, which amounts to quite 1,000,000 gallons. The question whether by combining with the production of arrack also the manufacture of power alcohol in large Government distilleries the cost of production would not be reduced is being discussed. There is every indication that the distillation of power alcohol will be taken up at an early date.

Two new 30-ton locomotives are being built by Messrs. R. & W. HAWTHORN, LESLIE & Co., Ltd., of Newcastle-on-Tyne, to the design of Capt. W. P. DURNALL; and if the trials are successful, one of the engines will be sent abroad from country to country for demonstration purposes. In one type the power is transmitted electrically from internal combustion super-Diesel engines to each of the driving axles. Compared with the best steam engine, it should show a fuel economy of about 60 per cent., it is claimed. In the second type internal combustion power is transmitted to the driving wheels by high temperature steam; but the important feature is the re-compression of the exhaust steam instead of being permitted to pass up the funnel in waste.

¹ *I.S.J.*, 1920, 469.

² *I.S.J.*, 1919, 86, 284.

³ *I.S.J.*, 1919, 342; 1921, 106.

The Question of Loss of Sugar by "Atomization" during Evaporation.¹

By W. D. HELDERMAN and C. SIJLMANS.

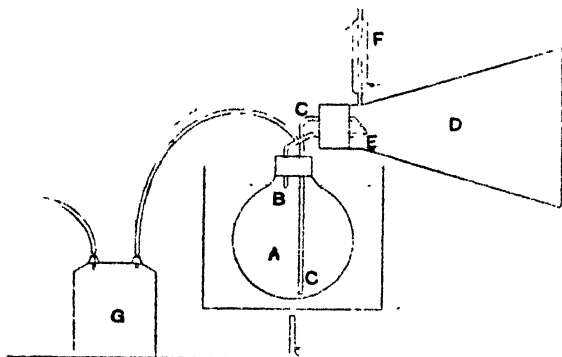
Recently SCHWEIZER² discussed a hypothesis according to which the sucrose molecule when transformed by the "atomization" of its solution into a very finely divided cloud becomes extremely sensitive towards reagents, and easily undergoes decomposition, even to the complete degradation of the molecule. In confirmation of this he mentioned different phenomena,³ into which it is unnecessary here to enter.

Later VAN HAM⁴ upheld this theory, and expressed the opinion that the repeated impacts and whirling movements of the atomized sucrose solution facilitate the decomposition process; while OLSEN⁵ concurred with the opinion of the gentlemen mentioned.

On the other hand, a more sceptical attitude towards this assumption was expressed by DE HAAN,⁶ with whose views we are wholly agreed. The investigation of this question was included in the 1921 plan of work of the Chemical Division of the Experiment Station, and accordingly we have endeavoured to give an answer to the question whether the atomization of sucrose solutions really can give rise to the decomposition of the sugar molecule. The procedure followed and results obtained in the investigation undertaken with this object here follow:

EXPERIMENTAL PART.

Flask *A* (having a capacity of 2 litres) is closed with a double-bored stopper, through which two glass tubes *B* and *C* pass. *B*, reaching to the neck of the



flask, is for the admission of the air; while *C* is drawn out to a capillary and bent (as is shown in the drawing), the rubber stopper closing a suction flask *D*, 40 c.m. (nearly 16 in.) high. In the flask *D* a constricted tube *E* is also inserted, a condenser *F* preventing evaporation as much as possible.

In operating this apparatus, pressure was made to bear on the liquid in *A* by means of an air-pump connected to the air reservoir *G*, the liquid being sprayed in a fine stream through the tube *C* into the flask *D*; while at the same time a rapid current of air was blown through *B* against the lower end of *C*, the liquid leaving it being thrown forward with force to the further end of the flask *D*.

During each atomization the particles travelled a distance of about 40 c.m. (nearly 16 in.), which, since each lot of liquid was submitted to this action 5 or 10 times, amounted altogether to about 2 or 4 metres (about 6½ or 13 ft.). During the tests *A* was placed in a water-bath, so that the temperature of the liquid was

¹ Translated from the *Archief*, 1921, 20, 495-500.

² *I.S.J.*, 1920, 706.

³ See *Comptes rendus*, 1919, 168, 1125-1128.

⁴ *Archief*, 1920, 28, 2098.

⁵ *I.S.J.*, 1920, 707.

⁶ *Ibid.*, 1921, 95.

maintained at about 90°C. (194°F.). In this water-bath a flask filled with the same liquid as that atomized was suspended, in order eventually to take into account any decomposition of sucrose by heating or otherwise. Tests effecting atomization *in vacuo* were also carried out, the above described apparatus being slightly modified for this purpose.

RESULTS OBTAINED.

In the tests in which atomization was effected at atmospheric pressure, 1 litre of 10 per cent. sucrose solution was treated 5 or 10 times, and the content in sucrose and reducing sugars determined.

	SUCROSE PER CENT.	REDUCING SUGARS PER CENT.
Untreated	9.02	0.26
Atomized 5 times	9.42	0.08
„ 10 „	9.63	0.12

Afterwards a litre of a 10 per cent. solution of sucrose was divided into two parts. One was inverted with a few c.c. of dilute sulphuric acid, neutralized with barium carbonate, filtered, and added to the uninverted portion, the following results being obtained with the mixture :

	SUCROSE PER CENT.	REDUCING SUGARS PER CENT.
Untreated	6.03	3.21
Atomized 5 times	6.19	3.21

Then a 10 per cent. solution of sucrose to which 2½ per cent. of potassium chloride had been added was submitted to the same treatment, the analysis showing the following figures :

	SUCROSE PER CENT.	REDUCING SUGARS PER CENT.
Untreated	9.75	0.13
Atomized 5 times	10.12	0.07

In the atomization experiments *in vacuo*, a 10 per cent. solution of sucrose was used, and also a like solution to which 2½ per cent. of potassium chloride had been added, the results being :

	SUCROSE PER CENT.	REDUCING SUGARS PER CENT.
Untreated	10.00	0.16
Atomized 5 times	10.26	0.06
Untreated using KCl	9.90	0.16
Ditto, atomized 5 times	9.94	0.12

All the atomized solutions re-acted neutral to litmus and phenolphthalein. Carbon dioxide could not be detected.

DISCUSSION OF THE RESULTS.

In the first place, it appears from the values found for the contents of sucrose and reducing sugars that neither by atomization in a current of air at atmospheric pressure, nor by atomization in a space under reduced pressure, does the decomposition of sucrose take place in any practically detectable amount, and further that the presence of potassium chloride or invert sugar exerts no influence.

The small differences occurring in the content of reducing sugars in some of the solutions (at most ± 0.06) fall within the limit of error of the methods of analysis (Muller's being used). That in each solution the sucrose content rose a few tenths of a per cent. after atomization may be attributed to the fact that the condenser used was not able wholly to prevent evaporation. If the increase in concentration thereby arising be taken into account, the content in reducing sugars becomes yet smaller.

Loss of Sugar by "Atomization" during Evaporation.

Considering that in practice only a very small fraction of all the juice has the opportunity of passing through the vapour pipes in the atomized state, and also that this investigation shows any losses arising from atomization to be so small as practically to be undetectable with certainty, it may be accepted with assurance that in factory operation no account need be taken of sucrose losses caused by atomization.

Straining Factory Juices, using the Carter Strainer.

For a long time sugar factory engineers have had in mind the need of a better system for straining factory juices. They recognize the method of straining over flat screens to be inefficient, and, on account of the labour and alteration required, also costly.

The Carter System of straining defecated juice by the installation of a revolving, vertical, automatic mechanical strainer has met the need,¹ to judge from the sugar factories in which this machine has been in use. Reports of the operation of this apparatus have been very satisfactory. It has become such a recognized factor in reducing expenses that duplicate orders are being placed. In spite of the general depression in the sugar industry, other mills are installing this system.

It has been suggested that the Carter Strainer should be re-designed for use in straining the juice *before* defecation. This has been done, and one machine is now being operated on the raw juice. By the end of the present season, it is hoped to be in a position to make a report on the results.

The Carter Strainer is a self-contained, revolving, automatic machine which can be operated by gravity, through the flow of the juice, where sufficient head room can be obtained; or it can be fitted with a mechanical drive, which requires approximately 1 H.P. to operate it. It consists of a series of screens, placed one above the other, with a central discharge passage for the bagacillo. After having passed through the screens, the juice flows from a clear juice outlet, in the bottom of the strainer, to the evaporator supply tank. Steam jets are arranged in suitable positions of the apparatus for its thorough cleaning and sterilization at suitable intervals.

The Carter Strainer is heavy in construction and the revolving parts run in ball bearings. The segments which contain the screen cloths are easily removable, so that new cloths may be attached when required. Another feature is that it is not necessary to stop factory operations to install the apparatus. It is designed to be placed on the steel girders of the factory building and can be put in position without disturbing the other working parts of the factory. The final connexions can be made over night or at the week-end stoppage.

The Carter Strainer not only eliminates the bagacillo and other ferment producing matter from the juice, but maintains the efficiency of evaporators and pans, by supplying them with cleaner juice. Centrifugal capacity is increased, because the massecuite purges freer. It makes possible the production of the sugar of higher polarization, which finds a ready market at better prices. The users of this device claim that it pays for its cost in a very short time.²

¹ See *I.S.J.*, 1920, 715.

² Sole Manufacturers: THE HORTON BROWN CORPORATION, 140, Broadway, New York. London Agents: THE SUGAR MANUFACTURERS' SUPPLY CO., LTD., 2, St. Dunstan's Hill, London, E.C. 3, from whom all particulars are obtainable.

Publications Received.

La Canne à Sucre à l'Ile Maurice. [The Sugar Cane in Mauritius.]
By P. de Sornay. 677 pages and 32 plates in the text. (Auguste Challamel, Paris.) 1921. Price : 50 frs.

Mr. de Sornay's book deals with the cultivation of the sugar cane in Mauritius; and so far as that colony is concerned it is a work of much interest, to the compilation of which the author must have devoted considerable time. He gives in the opening chapters data concerning the evolution of the sugar industry in Mauritius from 1800 to the present day; a short survey of the geology of the island; something about its climatology; and particulars regarding the introductions of cane into Mauritius since 1865. One of the principal sections of the book is comprised by the chapters devoted to the classification of the cane in Mauritius, and the merits of the several varieties at present cultivated. There are also good chapters on the history of seedling cane in the colony; the work of the experiment station; the cultivation of the soil for cane growing; the manures used; the merits of molasses as a fertilizer; cane yields; the composition of the cane; and the diseases and pests of the cane as occurring in Mauritius. Lastly in an appendix information is given regarding the excellent mutual chemical control that prevails among the factories there, a scheme that has proved to be of distinct value to the Mauritius sugar industry as a whole, and one which well may be emulated in other sugar producing parts of the Empire. Sugar manufacturers in Mauritius owe a debt of gratitude to Mr. DE SORNAY for his labours in writing this book. It forms a useful record of the present state of the sugar industry in Mauritius for the benefit, not only of planters in this progressive island-colony, but also of those in other countries.

Sugar: A Popular Treatise. By Allan Ray Kahn. Fourth Edition. (U.S. Sugar Publications Co., 108, West Second St., Los Angeles, Ca., U.S.A.) 1921. Price: \$2.00, net.

This is the fourth edition of Mr. Kahn's small book on beet sugar manufacture, and it differs little from the previous issue, which was noticed in these columns a short time ago.¹ It gives a clear and simple statement of the position regarding beet sugar manufacture in the United States, and forms a small treatise that should be found very useful by factory operators, agriculturists, and the general public.

Sugar Cane Machinery. W. Scott Herriot, Assoc.M.Inst.C.E., M.I.Mech.E. (Mirrlees Watson Company, Ltd., Scotland St., Glasgow.) 1921.

This is a reprint of a paper recently read by Mr. HERRIOT before the Manchester Association of Engineers. It gives a particularly clear and interesting outline of modern sugar manufacture, serving well to give a body of general engineers an insight into the processes and machinery employed in our industry. A number of good illustrations of plant of general design are also shown.

Power Alcohol: Proposals for its Production and Utilization in Australia.
Bulletin No. 20. (Institute of Science and Industry, Commonwealth of Australia, Melbourne.) 1921.

This is a reprint of Bulletin No. 6, which was an Interim Report of the Special Committee appointed by the Commonwealth Government in 1916 to enquire into the production and utilization of power alcohol in Australia. This Committee studied the question in its various aspects with great thoroughness, and their Report comprised a valuable summary of the position at the time of its publication. It reviewed the literature regarding the advantages of alcohol as a fuel; the substances which may serve as raw material for alcohol production; costs and yields; the adaptation of existing types of internal combustion to the new fuel; and lastly the denaturation of industrial alcohol. This reprint before us contains an addendum of 103 pages, which brings matters up-to-date by summarizing recent

¹ I.S.J., 1920, 406.

Publications Received.

literature on alcohol motor fuel issued in the United Kingdom, America, and elsewhere. In Australia the regulation concerning denaturation now prescribes the addition of 1 per cent. of wood naphtha, $\frac{1}{2}$ per cent. of pyridine, and 2 per cent. of either coal tar naphtha, shale naphtha, petroleum naphtha, petrol, or petroleum benzine or shale benzine. Commenting upon this new legislation, the Committee says that "the development of power alcohol on any considerable scale in Australia, therefore, depends on the importation of wood naphtha. . . . the price of which has steadily risen during the last few years. . . . If the full development of Australia's potential supplies of power alcohol is desired, the first matter to be settled is the question of denaturation. This is admittedly a difficult question, but until it is settled all schemes for distillation on any considerable scale must remain in abeyance. . . ."

- (1) **Root Disease in Cane.** (2) **A Cane Leaf Spot.** (3) **Observations on a Fungus** (*Cephalosporium Sacchari*, Butler.) (4) **Systematic Position of the Fungus causing Root Disease of Cane in Natal** Paul A. van der Bijl. (Department of Agriculture, Pretoria, Union of South Africa).
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Substitutes for (Cane Sugar) Sucrose in curing Meats. Ralph Hoagland. Contribution from the Bureau of Animal Industry, U.S. Department of Agriculture. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.) Price : 5 cents.

The Use of Low-Grade and Waste Fuels for Power Generation. John B. C. Kershaw, F.I.C. (Constable and Co., Ltd., London.) 1920. Price : 17s. net.

Whereas in past years the manufacturer in this country was favoured by the cheapness and plentifulness of his coal supply, now as one of the results of the war he is harassed by the increased cost of this essential commodity. It has become necessary for him to take a wide survey of combustible materials generally, and to impress into his service all that promise to yield a fair return for the capital and labour expended in utilizing them for heat or power generating purposes. Fuel conservation indeed has become the order of the day. Mr. Kershaw's book is divided into two parts ; in the first are described the various fuels that may profitably be used, such as peat, lignite, coke, culm, pitch, and waste gases, the conditions under which they may be burnt, and the appropriate plant for this purpose, also being discussed ; in the second part the important subject of scientific control is treated. In dealing with testing apparatus, it is insisted that they must receive skilled attention. Though automatic in action, they must be used with intelligence and care. When a sufficiently trained man is put in charge of the CO₂ apparatus, for example, the results obtained will be found of the greatest service in maintaining the conditions requisite for high efficiency in burning any low-grade fuel under steam boilers.

Prevention and Destruction of Rats. Elliot B. Dewberry. Demy 8vo. iv., 43 pages. (John Bale, Sons & Danielsson, Ltd., London, W. 1.) 1921. Price : 2s. net (paper covers).

Basic Slags, their Production and Utilization in Agriculture. (Faraday Society, 10, Essex St., Strand, London, W.C. 2.) Price : 7s. 6d.

This reprint contains papers on the utilization of basic slag by Dr. E. J. RUSSELL, F.R.S. ; the physical chemistry of basic slags, by Prof. C. H. DESCH ; and on other allied subjects, together with a report of a discussion taking place at a meeting of the Faraday Society.

Sugar Cane Cultivation in Florida for the Manufacture of Table Syrup.
A. P. Spencer. (University of Florida, U.S.A.)

Prussic Acid in Sorghum. S. E. Collison. Bulletin 155. (Experiment Station, Gainesville, University of Florida, U.S.A.)

Mr. NORMAN RODGER, 2, St. Dunstan's Hill, London, E.C. 3., has in the press and hopes to publish early in October a revised and enlarged edition of Noel Deerr's "Cane Sugar." This has been very largely re-written and re-illustrated by the author, so as to bring it up to date. It will consist of about 650 pages with 30 Plates (12 of them in colours) and 360 line illustrations. The price of the volume will be 42s. net (postage abroad 1s. 6d. extra).

Correspondence.

BAGASSE CARBON.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—In your June number (page 344) you comment on my answer to Mr. MORIZ WEINRICH.

I admit that for the purpose of a "Review of Recent Patents" the subject matter of my German Patent No. 322,135, of June 17th, 1920, was quite clearly stated in the abstract published in your January issue (page 54); but certainly for the purpose of boldly asserting the invalidity of the patent, as Mr. WEINRICH did (page 167), there were insufficient data in the said abstract, the claims not being stated.

Decolorizing carbons, I have found, have quite selective absorption properties. Gums and pectins are more easily absorbed by them than colouring matter, for example.

It, therefore, makes a great difference to the action of the decolorizing carbon with regard to the absorption of colouring matter whether or not a treatment for the absorption of the gums and pectins is made previous to the treatment with decolorizing carbon for the decolorization proper.

If the treatment of sugar juices and the like is carried out in two steps consisting of a pre-filtration with decolorizing carbon, followed by a treatment for the decolorization proper with such carbon, the technical result is surprising. When revived by special methods, the carbon can be used over again a thousand times.

Yours faithfully,

J. SAUER.

General Norit Company, Amsterdam,
June 15th, 1921.

[* * It is worth while supplementing Mr. Sauer's remarks by stating the claims of Mr. Weinrich's U.S. Patent, 455,675, of July, 1891: (1) As a material for the filtration of sugar solutions or other solution or liquids, the fibre, crude or charred, of the described grasses¹ whose stalks or stems have an internal marrow or pith. (2) As a material for the filtration of sugar solutions or other solutions or liquids, the comminuted stalks and cobs of Indian corn, crude or charred.

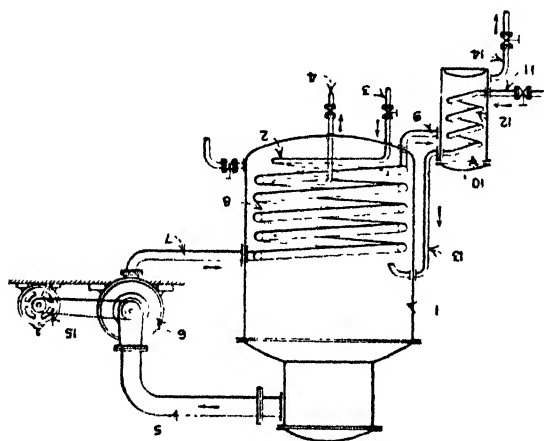
Having now published the claims attached to the two specifications in question, we leave our readers themselves to judge Mr. Sauer's patent relating to a method of preliminary treatment by bagasse carbon previous to the application proper of the decolorizing carbon on the essential points of: (1) novelty; (2) utility; and (3) inventive ingenuity.]

¹ Bagasse is mentioned in the body of the patent.

Review of Current Technical Literature.¹

"AUTO-VAPOUR" SYSTEM OF EVAPORATION, USING THERMO-COMPRESSION. *Gustav Carlsson. Chemical and Metallurgical Engineering, 1921, 24, No. 15, 645-647.*

In 1918 a firm in Switzerland began manufacturing their "Auto-vapour" evaporators, in which the vapour given off by the boiling liquid is compressed and used again. A number of plants employing this principle have been designed;² but in the case of the Swiss apparatus (which is said to have been largely installed for the concentration of salt, caustic soda, and sodium sulphite liquors) a successful development has been achieved by the invention of the high-speed compressor. Thermo-compression as a means of economizing fuel is being given a good deal of consideration by engineers connected with industries not so favourably situated as their colleagues engaged in sugar manufacture



using exhaust steam raised from a by-product fuel. Access to a cheap source of energy, such as water-power, is necessary for the compression of the vapour. In evaporating 1 lb. of water at 212°F. and atmospheric pressure, about 980 B.T.U. are used, or practically $\frac{1}{8}$ of the heat obtained from 1 lb. of coal. If the vapour be compressed to about three atmospheres, the temperature is raised to about 271°F., and an amount of energy equivalent to 106 B.T.U. is required, measured at the shaft of the pump with the efficiency taken into account.

On passing this compressed vapour through a coil submerged in the liquor under concentration, it is condensed with the liberation of its latent heat. This principle is put into practice in an apparatus operating upon the lines shown in the sketch. Steam is passed into the pan 1 through the valve 3 into the coil 2, and the liquid thus raised to boiling point. As soon as boiling has commenced, the steam feed is cut down, and the vapour being evolved is drawn off by pump 6 (driven by the electric motor 15) and compressed through the pipe 7 into the coil 8, where it is condensed, maintaining ebullition. Heat loss is very largely avoided by sending the condensate through the pre-heater 10, in order thus to raise the temperature of the liquid entering the pan to be evaporated, the cool condensate leaving by way of pipe 14. Some figures comparing thermo-compression with triple effect evaporation, based on tests made by Prof. STODALA at the Institute of Technology, Zürich, are given. In evaporating 2200 lbs. of water per hour in a vapour compression evaporator driven by electric energy, 51.6 k.w.h. and 41.7 lbs. of steam, the latter equivalent to 4.92 lbs. of coal, are necessary. On the other hand, using a triple effect evaporator for the elimination of the same amount of water, 132.73 lbs. of coal are required. Other figures are given showing that even when coal is used to produce the electric energy, the vapour compression evaporator will prove its superiority to a triple effect apparatus for the heating of which steam produced directly from coal is employed, by-product steam not being available.

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, I.S.J.)

² I.S.J., 1918, 310; 1920, 58, 117, 418, 713.

POWER ALCOHOL (ITS PRODUCTION FROM RICE STRAW, AND ITS DENATURATION).
Sir Charles H. Bedford. Journal of the Society of Arts, 1921, 69, No. 3577, 472-486.

In a lecture delivered before the Royal Society of Arts, London, on May 27th, some general information regarding the production of industrial alcohol in different countries at the present time was given. Following this, the lecturer stated that having been convinced of the conclusion that attention should be concentrated on waste vegetable materials rather than on foodstuffs, he had contemplated the use of elephant or Savannah grasses and of immature bamboos as joint sources of alcohol and paper. Recently with Mr. ARTHUR ROGERS, C.B.E., he had patented the idea of using rice straw for alcohol and paper production,¹ and large scale experiments have been undertaken at Rangoon, in order to prove on the spot the practicability of the proposition. There is no doubt (it is stated) that alcohol can be made from rice straw on commercial lines under the conditions employed, and by this scheme there result valuable by-products which very materially reduce the cost of manufacture. Later the lecturer dealt with the necessity for concerted action if good progress were to be made in introducing alcohol as a supplementary or alternative fuel to petrol. One of the most important considerations attached to the problem is denaturation. The Denaturation Sub-Committee of the Empire Motor Fuels Committee had reported that "as the result of a considerable amount of work, it was decided that redistilled bone oil was the substance which most closely complied with the desiderata for a denaturant as laid down by the Board of Customs and Excise" Light caoutchoucine in combination with secondary substances, such as shale oils, benzol, petrol, and sulphurous oil residues comes next in efficacy, but it is not known yet whether it would serve for motor use. One of the aims of the Committee is to bring about a simplification and cheapening of denaturation throughout the British Empire; and, if at all possible, procure a system of uniform denaturation throughout.

A long discussion subsequently took place, but only the more important points need be mentioned here. Dr. W. R. OLMANDY referred to the Classen method of hydrolysing cellulose for the production of fermentable sugars, pointing out that although largely used during the war, it does not appear to be a paying process. There is another method offering at least an equal chance of an early return, namely the direct synthetic production of alcohol from water-gas and producer gas by catalysis. He had seen ordinary water-gas converted to the extent of 90 per cent. into methyl alcohol of 99.2 per cent. purity. Eventually ethyl alcohol would thus be made. Mr. B. H. MORGAN, Chairman of the Alcohol Fuel Corporation, Ltd., London, owners of the "Natilite" patents, mentioned that if it were not for the excise and customs restrictions "Natilite" would be on sale in this country. However, he ventured to predict that in the course of 10 years, there would be very little petrol sold here, as "Natilite" (the most successful mixture that can be evolved from an alcohol basis) was infinitely superior to petrol for motor, aviation, and motor boat work. In replying to the discussion, Sir CHARLES BEDFORD made the important technical statement that "in regard to the amount of acid required, very small amounts were needed in the process; in fact, mere traces."

MAURITIUS MOLASSES, ITS PRODUCTION, COMPOSITION, FINE GRAIN CONTENT, NON-FERMENTABLE MATTER, YIELD OF ALCOHOL FOR MOTOR FUEL, AND THE VALUE OF ITS VINASSE FOR FERTILIZING PURPOSES. *H. A. Tempany. Bulletin No. 21, General Series, Department of Agriculture, Réduit, Mauritius.*

DR. TEMPANY publishes an amount of useful information regarding cane molasses, particularly that resulting from sugar manufacture in Mauritius, which should be of interest at the present time in view of the steps being taken in different countries to utilize this by-product for motor fuel, such as "Natilite." In Mauritius during the past seven years the average annual production of sugar has been 229,000 metric tons, and assuming that 180 litres of exhausted molasses are produced per ton of sugar (a conservative estimate)

¹ I.S.J., 1920, 680.

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the average annual production of molasses is about 41,000,000 litres.¹ There are three distilleries in the Colony, in which during 1918-19 the spirit made was 1,529,315 litres at 23° Cartier, equivalent to 932,882 litres² of absolute alcohol, a quantity of which is denatured and used locally. The use of molasses as fertilizer has been very widespread in Mauritius;³ but there is reason to believe that its vinasse might be used instead without loss of fertility, and if this is so then probably about 30-35 million litres of molasses would be available annually for fermentation to power alcohol. Regarding the composition of Mauritius molasses, 18 samples were collected from different factories and analysed with the following average result: Total solids (refractive index), 78.4; sucrose (Clerget), 35.1; reducing sugars, 14.9; ash, 10.1; organic non-sugars, 18.3; and water, 21.6 per cent.; the purity being 45.3. PIROT⁴ in 1914 obtained the following figures on examining 8 samples: sucrose (Clerget), 32.9; reducing sugars, 16.7; and ash, 8.8 per cent. In the case of Hawaiian molasses,⁵ these three constituents average 35.9, 14.0 and 10.8; while in that of Javan⁶ they are: 33.3; 28.4; and 9.6 per cent. It was suggested to Dr. TEMPANY that the ratio of reducing sugars to ash might depend upon the rainfall of the district of the production, and on examining this point this ratio was found to vary as follows: rainfall, 50-60 in., ratio, 1.25; 75-100 in., 1.37; and 100-125 in., 1.72; so that there seems to be a fairly well-marked tendency towards a lower ratio in relatively dry districts, possibly owing to the absorption of a larger amount of mineral salts by the cane from the soil. On examining 18 samples of Mauritius molasses in regard to their grain content, following Kalshoven's method,⁷ values varying from 0.30 to 2.62, and averaging 1.18 per cent., were obtained, considerably lower than those found by the Dutch investigator. Glucose, the unfermentable sugar first described by MACQUEENNE,⁸ was determined by Pellet's method,⁹ and found to amount to 2.22 per cent. (the average of four samples), which agrees very well with the amounts found elsewhere (2.4-3.2 per cent.).

Coming to the question of the probable yield of alcohol from Mauritius molasses with adventitious yeast as now used in distilleries in the Colony, 84.4 per cent. of the theoretical possible was obtained, and 91.2 per cent. when the adventitious type had been purified by cultivation in a solution of sucrose containing nutrient material. Tests actually made in one of the distilleries gave only 73.3 per cent. Accepting a possible yield of 94 per cent., and with sucrose and fermentable reducing sugars contents of 35.0 and 12.7 (i.e., 14.9-2.2) per cent., this should give 23.7 grms. of absolute alcohol per 100 grms. (sp. gr. 1.440), or 0.435 litre of absolute alcohol per litre of molasses. Lastly, the matter of the use of vinasse as fertilizer is treated. An exhausted vinasse from a Mauritius distillery gave the following figures in grms. per 100 c.c.: sugar as invert, 3.57; ash, 3.13; and organic non-sugar, 10.97, the latter containing 0.17 grms. of nitrogen. Field experiments carried out at Réduit in 1916-17 gave results substantiating the data previously adduced as to the beneficial effect of molasses. Vinasse had increased the yield by an amount considerably smaller than that shown by molasses; but, "bearing in mind the much smaller attenuation of the wash, the result indicates that satisfactory results will probably follow such applications." This attenuation of the vinasse is a disadvantage in respect of distribution compared with the more concentrated molasses. It might be run on to the fields by means of suitable channels alone or mixed with irrigation water; but only estates in close proximity to the distillery could be supplied in this way, and those more remote would be deprived of a valuable fertilizing constituent. Suggestions made for overcoming this difficulty are: (1) the concentration of the vinasse where surplus bagasse is available; and (2) the acclimatization of the yeast to denser worts, as proposed by PECK and DEERR.

CENTRIFUGAL PISTON PUMPS. *Berthold Block. Deutsche Zuckerindustrie, 1920, 45, 587.*

¹ That is, nearly 21 per cent. of the sugar produced. In Hawaii it is about 25 per cent.

² Or 205,234 imperial gallons. ³ *I.S.J.*, 1920, 469.

⁴ *Bull. Soc. Chim. Maurice*, 1914, 8, 47.

⁵ PECK and DEERR: *Bulletin 28, H. S.P.A.*

⁶ *Annual Synopsis of Mill Data, 1919, Java Proefstation.*

⁷ *I.S.J.*, 1919, 608-610.

⁸ "Les Sucres."

⁹ *I.S.J.*, 1917, 275.

MANUFACTURE OF TABLE SYRUP, USING KIESELGUHR FOR CLARIFICATION. *J. K. Dale and C. S. Hudson. Bulletin No. 921, U.S. Department of Agriculture.*

Zerban's recently described method of clarifying cane juice with kieselguhr (adding neither lime nor sulphurous acid¹) is discussed from the point of view of the Louisiana syrup maker, the procedure recommended being to heat the juice to a point just below boiling, add 10-12 lbs. of the infusorial earth per 200 gall. of juice (that is, the amount from 1 ton of cane, the extraction being 78 per cent., and the dilution 14 per cent., giving a mixed juice of 13° Brix), and to pump the whole while still hot through filter-presses. In the case of six lots of juice each of 200 gall., the course of filtration was as follows:

Lot	TIME, IN MINS.	PRESSURE, IN LBS. PER SQ. IN.
First	15	10
Second	15	20
Third	25	30
Fourth	40	40
Fifth	45	50
Sixth	65	60

And it is said that no trouble at all was experienced in obtaining a steady clear filtration and a firm press-cake, which could be washed down to a sucrose content of 1 per cent. It is estimated that the juice from 50 tons of cane could be easily filtered through 200 sq. ft. of filter-press surface in 24 hours, including the time necessary for dressing and cleaning. In a syrup factory crushing 50 tons of cane per day, 550 lbs. of kieselguhr at about 2 cents per lb., would cost \$11; and one man extra each shift at \$2.50, gives \$5, that is, a total of \$16 or 32 cents per ton, to which must be added interest at 6 per cent. on the investment of extra plant, 3.4 cents.; depreciation at 10 per cent., 5.6, and filter-cloths, 2.6, giving a total extra cost of 43.6 cents per ton of cane. On the other hand, one must take into consideration the fact that much less sugar is lost. Thus in ordinary clarification by skimming during heating, it is calculated that 25-50 gall. of syrup per 50 tons of cane is lost; in the infusorial earth process when the cake is not washed, 17 gall.; and in the same method when the cake is exhausted to 1 per cent., only 3 gall. Therefore, assuming 25 gall. are saved, this at \$1.00 per gall. gives 50 cents per ton, so that the increased cost of this process, viz., 43.6 cents, is fully covered by the new system of working. A superior product having a milder flavour than the present Louisiana type, and lighter in colour and cleaner than the Georgia syrup, was obtained by this procedure of clarifying with kieselguhr and subsequently evaporating in vacuum apparatus.

CONSTRUCTION OF ALIGNMENT CHARTS OR NOMOGRAPHS AND THEIR USE FOR CALCULATING THE WATER ELIMINATED IN EVAPORATION. *A. J. V. Umanski. Chemical Trade Journal, 1921, 233-236, and 269-272.*

If in the case of 100 lbs. of a solution (as juice) the strength of which is a , one requires to know how much solvent W (i.e., water) should be removed to raise the strength to b per cent., the relation $100a = (100 - W)b$, or $W = 100 \left(1 - \frac{a}{b}\right)$ is applied. To construct a nomogram for $W = 100 \left(1 - \frac{a}{b}\right)$ so that we can see at a glance how W varies with different values of a and b , the formula is put into the form $a = b \left(1 - \frac{W}{100}\right)$ which is of the form $u = vw$, represented by three equidistant parallel logarithmic scales, the u scale being midway between the v and w scales, and being graduated with a modulus equal to half that of the v and w scales. Instead, however, of simply marking v on the scale, we mark off the values of W at points whose distance from the origin is proportional to $\log. \left(1 - \frac{W}{100}\right)$. This is obviously equivalent to graduating the scale for values of $\left(1 - \frac{W}{100}\right)$ initially, and re-graduating it for the corresponding values of W . Thus, for

¹ *I.S.J.*, 1920, 699.

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example, for a value of W equal to 50 we have $\left(1 - \frac{W}{100}\right) = 0.5$, and $\log. 0.5 = \bar{1}.6990$, and the point with the corresponding distance from the origin will be graduated, for W equals 50. The negative characteristic of $\log. 0.5$ simply signifies that the logarithmic scale representing $\left(1 - \frac{W}{100}\right)$ is moved back bodily so that it terminates at the origin instead of commencing there. Alternatively putting $\log. 0.5 = -0.3010$, it would be equivalent to measuring this distance on the W scale in the opposite direction to that in which we measure the distances for the points on the a and b scales, thus observing the usual convention as to the sign of linear measurements. The line joining $a = 1$, $b = 1$ obviously gives $W = 0$, or $\left(1 - \frac{W}{100}\right) = 1$, which fixes the starting point of the W scale.

KALSHOVEN'S METHOD OF DETERMINING GRAIN (FINE CRYSTAL) IN MOLASSES. *W. D. Helderman and C. Sijlmans. Archief, 1921, 29, 253-255.*

Kalshoven's method¹ has been subjected to a good deal of criticism, to which he has left himself open by neglecting to publish any results of control tests showing figures for molasses containing definite amounts of fine grain. These data the authors now supply by giving the results of three series of experiments. (1) Portions of 100 grms. of molasses of unknown grain content were placed in two flasks, 10 grms. of water added to the first, and 10 grms. of water plus 5 grms. of fine sugar crystals to the second. Complete solution was effected in both cases, following which the refraction was observed, the results for the dry substance being in the case of the original molasses and the two tests (calculating on the undiluted molasses), 85.58; 87.30; and 87.88 per cent. respectively. According to Kalshoven's formula, the grain contents of the two tests are 11.93 and 15.95 per cent.: and assuming that the grain content of the first is 11.93, then with the addition of 5 grms. of sugar this becomes 16.12, which agrees well with 15.95 as found. (2) Into three flasks each containing 100 grms. of a molasses containing a little grain, 10 grms. of water, 10 grms. of water plus 2 grms. of sugar, and 10 grms. of water plus 10 grms. of sugar were added. After complete solution, the refractive readings gave dry substance contents of 84.48, 84.81, and 85.93 per cent., which values correspond to 2.08, 4.16, and 11.23 per cent. of grain respectively. Thus the results for the flasks to which 2 and 10 grms. had been added were 4.0 and 10.96 per cent. respectively. (3) To two portions of 50 grms. of grain-free molasses saturated with sugar, 2.5 and 5.0 grms. of water only were added, and after mixing the dry substance was found to be 79.04 and 79.17, that of the original molasses being 79.18 per cent. It is therefore concluded that provided sufficient care be taken, Kalshoven's method gives sufficiently accurate results. Too much water must not be added to dissolve the grain, as then an error due to contraction on solution arises, 10 grms. of water to 100 grms. of molasses generally being sufficient when the grain content is less than 20 per cent., which fortunately appears to be usually so. That DEDEK² obtained a result indicating 4.89 per cent. of grain on diluting with 97.3 per cent. of water is quite comprehensible.

ADSORPTION ISOTHERMS FOR "NORIT" DECOLORIZING CARBON AND BLOOD CHARCOAL. *H. R. Krut and C. F. van Duin. Recueil des Travaux chimiques des Pays-bas, 1920, 39, No. 9, 679-684.*

In order to determine whether "Norit" was as suitable for research work as Merck's "acid purified blood carbon," the adsorption isotherms for (1) the hydrogen ion of hydrochloric acid; (2) the hydroxyl ion of sodium hydroxide; and (3) phenol (as an example of an organic non-electrolyte) was examined. It was found that the isotherms were altogether more regular in the case of "Norit" than in that of the other preparation, though the power of adsorption of the latter was noticed to be somewhat greater than that of the former in the case of these experiments. In some of the tests the "Norit" was purified by boiling first with dilute hydrochloric acid and then with water.

¹ *I.S.J.*, 1919, 808; 1921, 169.

² *I.S.J.*, 1921, 327-330.

REVIEW OF RECENT WORK DONE ON ENZYME ACTION. *R. J. S. McDowall. Science Progress, 1921, No. 59, 406-434.*

Much of the advance in our knowledge of enzyme action has been made side by side with, and is almost consequent on, the great advances in our knowledge of inorganic catalysts, surface action, and colloids. It is now accepted that practically all enzymes are colloids, or are associated with substances having colloidal properties, being found together with protein matter in a large number of cases; and in this article the subject is discussed from this point of view. One of the most important phases concerns synthetic action, it having been found that many hydrolytic ryzyme actions are reversible. Suggestive researches have been carried out along this line by BOUQUELOT, who has synthesized α and β glucosides from primary alcohols, using the maltase of yeast and emulsin respectively; and BAYLISS has confirmed some of these results. More definite and conclusive work has yet to be done in this direction, especially on the factors governing the reaction; but that done so far would almost lead one to presume that enzymes which hydrolyse also synthesize. This, therefore, is a subject of great importance to the bio-chemist.

ANALYTICAL METHOD OF DETERMINING THE WEIGHT OF DEFECCATION SCUMS (PRESS CAKE) INDIRECTLY. *A. V. Bulletin de l'Association des Chimistes de Maurice, 1920, 12, No. 42, 53-56.*

A method of calculating the weight of press cake from data obtained in the laboratory is proposed, these data being the fibre in the juice, the fibre in the press cake, the dilution and the normal juice. In determining the fibre in the mixed or diluted juice, the sample brought to the laboratory is weighed, its density taken, and a suitable amount passed through a cylinder of very fine wire gauze, 12-15 cm. ($4\frac{3}{4}$ — $6\frac{1}{4}$ in.) high and 5 cm. (2 in.) diam., the residue retained being washed with water, transferred to a tared basket made of perforated copper sheeting about 15 cm. ($6\frac{1}{4}$ in.) diam., and 5 cm. (2 in.) wide. This operation is repeated in the case of each sample of juice taken during the day or night shift, at the end of which time the material collected in the tared basket is placed in a suitable press, as much water expelled as possible, and then dried to constant weight in the oven, the weight of "fibre" per 100 of juice being calculated. This dried fibre is then placed in a flask marked *J*. Similarly the fibre in the samples of press cake is ascertained, and the dry fibre obtained transferred to a flask marked *P*. Since the composition of the fibre in the juice does not correspond with that of the press cake, determinations are made of the relative amounts of ash, waxy and nitrogenous substances in each, the method of calculating the final result illustrated by figures obtained in a large usine in the Island of Réunion being as follows: Fibre in the juice, per cent., 0.109; apparent fibre in the scums, 4.640; water added, per cent. of the mixed juice, 20; normal juice per cent. cane, 77.69. By subtracting the figures found for the analysis of the juice and press-cake fibres in the flasks *J* and *P*, a conversion factor is found.

	SCUM FIBRE.	JUICE FIBRE.
Ash	9.325 minus	4.250 = 5.075
Waxy Substances	3.075 „	1.325 = 1.750
Nitrogenous Substances	3.300 „	2.625 = 0.875
		<hr/> 7.700

and $100 - 7.700 = 92.30$, the factor desired. Therefore: True fibre in the scums = $\frac{4.64 \times 92.3}{100} = 4.28$. Diluted juice per 100 of scums, $\frac{4.28 \times 100}{0.109} = 0.3926$ kg. Normal juice per 100 of scums, $\frac{3926 \times (100 - 20)}{100} = 3140.8$ kg. Scums per 100 of cane, $\frac{100 \times 77.69}{3140.8} = 2.473$ kg.

Review of Current Technical Literature.

CHEMICAL PROBLEMS OF THE BEET SUGAR INDUSTRY [INCLUDING DATA ON ASH OF BEETS, DIFFUSION JUICE, AND MOLASSES; COMPOSITION OF MOLASSES; AND RÔLE OF "RAFFINOSE" IN EXHAUSTION BY THE STEFFEN PROCESS] *H. W. Dahlberg. Chemical and Metallurgical Engineering, 1920, 23, No. 10, 421-426.*

In the following table is shown the amount and analysis of the ash of typical samples of beets grown in Colorado, Utah, and Michigan; and of the juice and molasses obtained:—

Per cent. lixiviated ash by weight..	Beets.	Diffusion Juice.	Molasses.
Analysis—	0.85	.. 0.53	.. 11.80
Silica and insoluble ash	2.64	.. 2.00	.. 0.86
Iron (Fe)	1.84	.. 0.22	.. 0.11
Calcium (Ca)	0.69	.. 0.44	.. 0.51
Magnesium (Mg)	2.05	.. 3.39	.. 0.34
Potassium (K)	30.36	.. 31.44	.. 40.40
Sodium (Na)	11.28	.. 11.05	.. 8.68
Chlorine (Cl)	6.87	.. 7.71	.. 9.76
Sulphate (SO ₄)	3.61	.. 5.92	.. 10.74
Phosphate (PO ₄)	7.42	.. 7.54	.. 0.40
Carbonate (CO ₃)	30.98	.. 30.43	.. 28.74
Undetermined	2.17	.. —	.. —
Total.. . . .	100.00	100.00	100.00

Thus, the composition of the ash in the diffusion juice remains about the same as in the beets, though its amount may be reduced by 20-30 per cent. If a cheap process of precipitating the sugar from the diffusion juice in an insoluble form leaving the non-sugars behind could be found, the yield of granulated would be increased by about 15 per cent. American beet molasses has approximately the following composition:—

Moisture	21.00	Raffinose	0.85
Direct polarization	52.08	Invert Sugar	0.06
Sugar by double polar- ization	50.51	Ash.. . . .	12.17
		Undetermined	15.41

One of the serious difficulties connected with the Steffen process is the relatively low purity of the calcium trisaccharate cake re-introduced into process, a number of impurities being precipitated by the lime together with the sucrose, accumulating in the final molasses to such an extent that the yield of sugar by the Steffen operation becomes too small to be profitable. It then becomes necessary to discard the molasses, and thus eliminate the objectionable impurities. "Raffinose," as determined by the double polarization process, causes the most trouble, a part of this figure thus indicated being actually due to the trisaccharide, and the rest to other optically-active bodies. A peculiarity regarding so-called "raffinose" is that the calcium saccharate shows 20-40 per cent. more than was originally present in the molasses treated, no explanation of this having been suggested. Moreover, in climates where the roots during growth are not exposed to freezing climates (as in California) no raffinose accumulates in the molasses; but elsewhere (as in Colorado, Utah and Michigan) it is found advisable to dispose of 25-40 per cent. of the molasses during the season. These problems have been under the consideration of the author (who is Research Manager of the Great Western Sugar Co.); and he has also been investigating the worth of distilling the Steffen waste waters to recover cyanide, methylamines, methyl alcohol, etc., and also refine the potassium salts left in the retorts.

REPORT OF THE MOST IMPORTANT WORK DONE DURING THE SECOND HALF-YEAR OF 1920 IN PURE SUGAR CHEMISTRY. *E. O. von Lippmann. Deutsche Zuckerindustrie, 1921, 46, 37-38, 50-51, 63-64, 80-81, 95-96.*

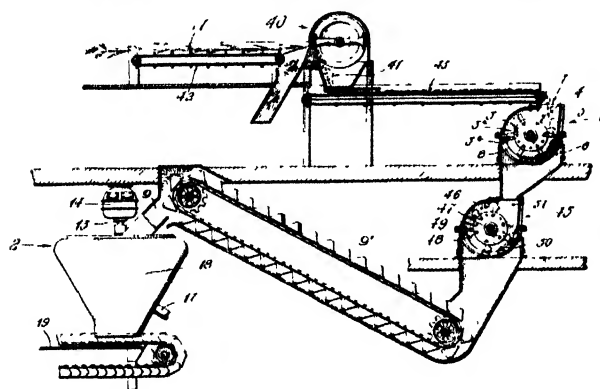
J. P. O.

Review of Recent Patents.¹

UNITED STATES.

EXTRACTION OF SUGAR FROM CANE. *Frank H. Lindenberg*, of Columbus, Ohio, (assignor to the *Jeffrey Manufacturing Co.*, of Columbus, Ohio, U.S.A.). 1,369,180. February 22nd, 1921.

One of the objects of the invention is to subject the cane to a treatment whereby it will be completely reduced to a pulp with particles so fine that the solid matter loses its fibrous character, and the ultimate cells are broken open and their liquor released. Several mechanisms may be used. For example, in the drawing at 40, is an apparatus for cutting the cane into short sections previous to comminution in the disintegrator 1. This comprises a casing 5 within which there is the rotary element 3, consisting of a rapidly revolving shaft 3a with discs 3b and pulverizing arms 4 pivoted to the discs. Grate bars 6 are arranged in a concave series in close proximity to the paths of rotation of the ends of the disintegrating bars, with which they co-operate in reducing the solid



part of the cane to fine shreds, the speed being about 1200 revs. per min., or more. A mass of fine shreds with nearly all the liquor-containing cells broken open is thus produced; but in order to carry the reduction of the solid matter still further the cane is passed through the beating mechanism shown at 45. It has a casing 46 and a rapidly rotating element comprising a shaft 47 with

discs 49 secured to the shaft. But the arms 48 are arranged and adapted to impart blows or pounding actions. Each of these arms is rounded and wide surfaced. As the shreds reach the concave table 50 they are struck by the rounded heads or ends of the pounding arms 48, and these exert a powerful flattening action upon the small fibres and act to crush open the last of the cells that may still remain intact after the preceding treatment. The parts can be so constructed and related that the walls of the cells in the fibres are reduced to a pulp by this action.

At this stage the cane has been reduced to a pulpy condition permitting the ready separation of its solid and liquid contents; but the repeated pressings and washings ordinarily used in milling are no longer necessary, the material having lost its absorbing power. This separation is effected in the apparatus 2, which is a type of centrifugal machine, driven by the motor 14, the fibre gradually passing up a perforated screen until it travels over the top and drops upon the conveyor 19, while the liquid passes through the perforations and finally leaves the apparatus through the duct 17.

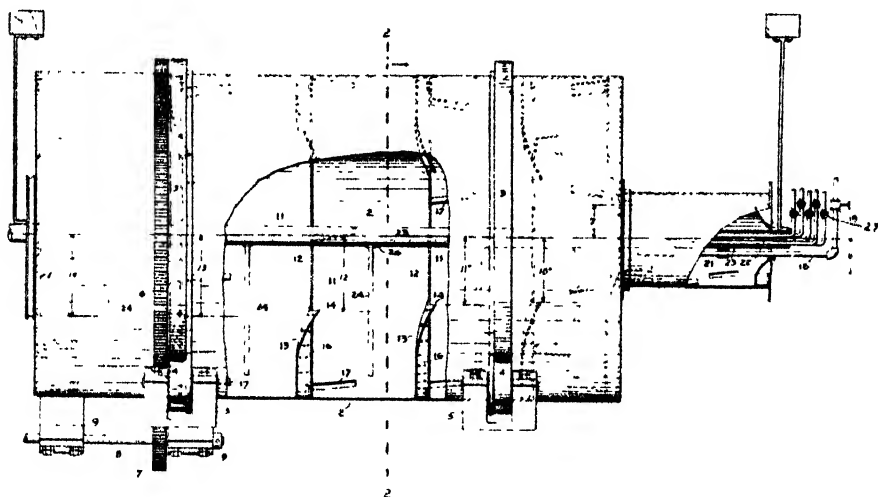
HARVESTING SUGAR CANE. *Percy T. Woodland*, of New York, N.Y., U.S.A. 1,365,213. January 11th, 1921. (Twelve figures.) See also U.K. Patent, 155,023.²

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

² *I.S.J.*, 1921, 235.

EXTRACTION OF SUGAR FROM BEETS, ETC. *Guy S. Dyer*, of Layton, Utah, U.S.A.
1,353,463. September 21st, 1920. (Two figures.)

The material is fed through an opening 1 into one end of a cylindrical chamber 2, which can rotate by means of circular rails, travelling upon flanged rollers mounted in suitable bearings, and is divided into compartments 11, five of which are here shown, although in practice more (as 7 or 8) are used. These compartments are formed by annular plane transverse partitions 12, the outer edge of each partition being connected in any suitable manner with the cylindrical body 2. Extending in front of each partition are two diametrically opposite shifter plates 13, which are perforated and extend at an angle to the partition, so that the front edges of said plates, having regard to the direction in which the cylinder rotates, are closely adjacent to said partition, while the rear edges are at a considerable distance therefrom. The inner portions of said shifter plates extend inwardly, through the openings in the partitions, as shown at 14. These shifter plates tend to convey the material from the outer to the inner portion of the cylinder and cause it to pass through the holes in the partitions. They are perforated so as to strain the material, while so shifting it from one compartment to the next, the strained liquor flowing through said perforations into chambers 16 between the shifter plates and the partitions. Vanes 17 extending inwardly from the wall of the chamber



are also provided, being arranged on said wall in a general longitudinal direction but obliquely to the axis of the cylinder, the vanes as well as the plates 13, serving to move the material being treated toward the centre of the cylinder and thus cause it to pass through the holes in the successive partitions.

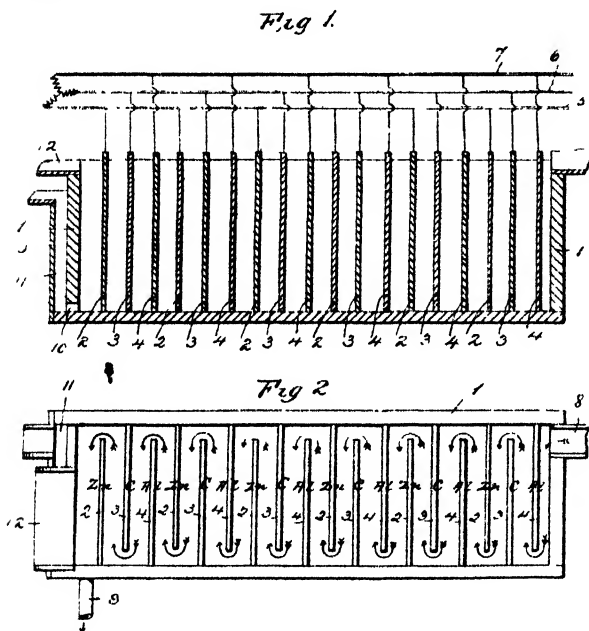
While the material is thus being passed through the several partitions from one end of the cylinder to the other, hot water is fed into the cylinder by a pipe 18, controlled by a valve 19, the pipe 18 extending only into a terminal washing chamber 21 connected with the discharged end of the cylinder and co-axial therewith, from which washing chamber 21 it flows into the cylinder, flowing through the openings in the partitions as the level of the water rises to the above said openings, and finally flowing out through the feed opening 1 at the feed end of the cylinder. In order to increase the leaching action of the water, it is additionally heated in its progress through the leaching cylinder by means of steam pipes 22 of which there are as many as there are compartments in the leaching cylinder, these steam pipes being all inclosed within a tube 23 extending co-axially with the cylinder and being connected with transversely extending branch pipes 24, which extend downward a sufficient distance to discharge below the level of the water in the partitions, while the branch pipes extend through holes 26 in the inclosing tube 23.

ELECTROLYTIC PURIFICATION OF CANE JUICE. *Elie Delafond*, of Habana, Cuba. 1,371,997. March 15th, 1921. (Two figures.)

Raw juice is made to flow between electrodes supplied with low voltage direct or alternating current or three-phase current, the rate of flow being such that deposition of salts on the electrodes is prevented. Contact of the juice with the electrodes should not be too long, say 5 mins. maximum when employing a current of 6-10 volts and a total amperage of 10-60 amps., giving a current density of $\frac{1}{10}$ am. per sq. cm. Carbon, zinc, aluminium, lead and other metallic plates may be used as electrodes. After months of use, no wear of the surface may be perceived, though if the rate of flow is insufficient a coating of slime soon collects.

As is shown in the drawings, the apparatus comprises a wooden or other tank 1 rectangular in section, provided with zinc electrodes 2, carbon electrodes 3, and aluminium

electrodes 4. These are connected either to bus-bars, or to the respective line wires 5, 6, 7, of a three-phase line delivering about 4 to 10 amps. of current per sq. cm. of electrode surface. A 60-cycle 100 amp. dynamo machine may be used, only 10 to 60 amps. being employed, so as to operate within safe limits. All the zinc electrodes 2 are connected to one phase 5, all the carbons 3 to the second phase 6, and all the aluminums 4 to the third phase 7. These electrodes are staggered so as to form a zig-zag passage for the electrolyte, and are spaced approximately 50 cm. apart. The juice enters through a trough 8 to one end of the tank 1, and passes between the electrodes in a zig-zag path from one end of the



tank to the other, leaving through a pipe 9. The precipitated impurities pass through a slot 10 into an overflow chamber 11, while some scum accumulates behind the last electrode, and either passes through the spout 12 to the filter or is skimmed off and discharged to a filter. The rate of flow of the juice through the zig-zag passage between the electrodes is about 5 meters per min., that is, sufficiently rapid to prevent both heating and the deposition of slimes on the electrodes. It should preferably be slightly acid, using sulphurous acid or phosphoric acid. It is possible to get the same effect in a metallic tank stirred by a second electrode to give sufficient motion to the juice or syrup.

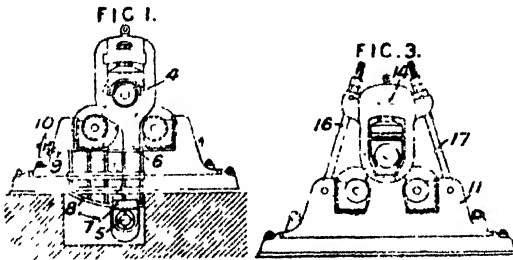
Operating in this way, the soluble salts contained in the juice are rendered insoluble; while gums, wax, and other colloids are precipitated. Partial re-solution will occur, however, if the temperature be too high, that is, above 71°C. Tests before treatment showed 81.16° Brix, 69 per cent. of sucrose, and 85.02° purity; and after purification in the manner described, 79.3° Brix, 71.26 per cent. sucrose, and 89.84° purity.¹

¹ This process has been tried out in Cuba, the inventor having claimed that by its application it is possible to make a fine white product at practically the same cost as 96° test raw, while obtaining a higher yield.

UNITED KINGDOM.

MILL WITH A MOVABLY-MOUNTED TOP ROLL. *Frederick J. de Bruin, of Rotterdam*
162,533 (10,991). April 20th, 1920.

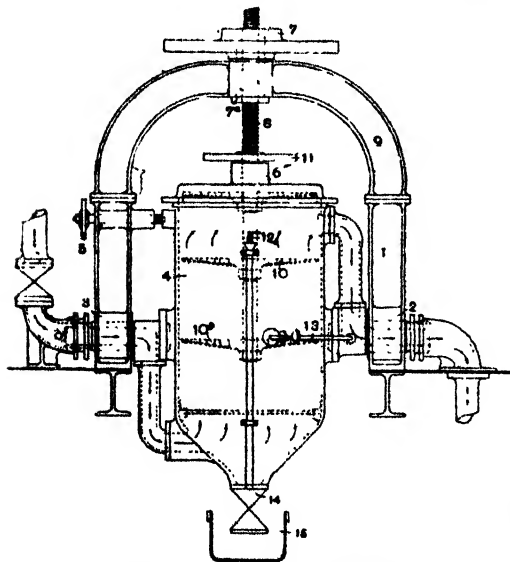
In a sugar cane mill with a movably-mounted or floating top rail, the direction of the hydraulic pressure acting on the top roll is inclined to the plane containing the axes of the side rolls, and the direction may be adjusted as required.¹ As shown in Fig. 1, the pivots 5 of the two pendulums 6 which support the top roll 4 are mounted in shoes or blocks 7 which can be moved over curved tracks 8 by means of screwed rods 9 operated by



nuts or hand-wheels 10. In another arrangement, Fig. 3, the upper section or cap 14 containing the top roller is connected to the lower section 11 of the housing by bolts 16, 17, so that by lengthening one bolt and shortening the other the cap can be placed in the desired oblique position. (Or the plungers of the hydraulic apparatus of the top roller may

be moved over curved tracks fixed to the upper part of the housings, the top roller being mounted on roller bearings arranged between bearing-bushes and the cylinders of the hydraulic rams. In another arrangement, the top roller and its hydraulic apparatus are mounted within oscillating yokes pivotally mounted between the lateral faces of the main housings. In another form of the tie-rod type of mill, the pivots of the pendulums carrying the top roller can be placed in any one of a series of holes in the lower parts of the pendulums and in bearing-blocks secured to the bedplate of the machine.

FILTER, USING BAGASSE OR LIKE MEDIUM.² *James Miller and George Fletcher & Co., Ltd., of Derby.* 161,993 (11,142). May 5th, 1919. (One drawing.)



A filter comprising a chamber mounted on trunnions 3, 2, through which the liquid is supplied and discharged, has one end closed by a cover 6, separately mounted and rapidly operated, and is provided at the other end with a stop-cock 14 for draining off mud or sediment. When sugar liquor is to be filtered, bagasse may be used as filtering medium. The bagasse is compressed by a follower 10 forced down by a spindle 8 passing freely through the cover 6 and rotated by means of a nut 7 which turns freely in a yoke 9. A nut 11 gives packing pressure to the cover 6. The upper part of the chamber may be provided with a test cock 12 and with a pipe and cock 13 for drawing-off liquor above the filtering medium prior to emptying the

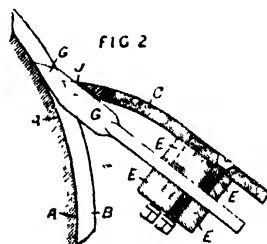
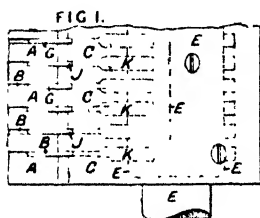
chamber. (Reference has been directed by the Comptroller to Specification 23586/95.).

¹ Compare also U.K. Patent, 149,289; *I.S.J.*, 1920, 713.

² Cf. also U.K. Patent, 158,387; *I.S.J.*, 1921, 299.

SCRAPERS FOR GROOVED MILL ROLLERS. *William Mackie (A. & W. Smith & Co., Ltd., of 120, Dale Street, Glasgow, S.S., Scotland). 162,124 (4317). February 12th, 1920; April 28th, 1921. (Two figures.)*

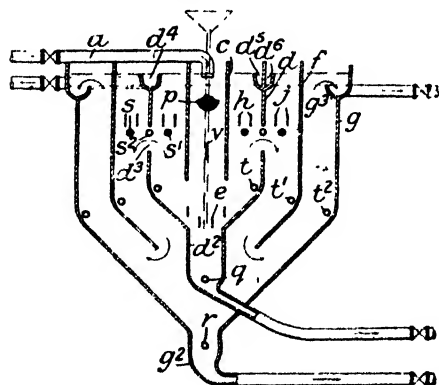
The invention has for its object to provide simple, effective, and easily adjustable means for clearing the fragments of bagasse from the grooves on the discharge roller of the mill. As is shown in the drawings, the discharge roller *A* of the mill is formed as



usual with deep circumferential grooves *B*, and there is also provided, to co-act with the roll, a bagasse discharge table *C*, secured by screws to a usual supporting bar *E*, the heads of the screws being countersunk. According to the invention, there are provided a series of scrapers *G*, one for each groove *B* in the mill. The shanks *K* of these scrapers are circular and are adjustably secured in the table supporting bar *E*. Slots *J* are cut in the forward scraping edge of the ordinary bagasse discharge table *C* to permit the scraping ends of the blades *G* to pass and enter the grooves *B* of the roll *A*, to which grooves the scraping ends are substantially counterpart. These means of holding the scrapers *G* permit of easy adjustment, in order to effect the complete removal of the fragments of bagasse lodged in the grooves and to discharge them on to the bagasse table *C*.

SETTLING TANKS FOR THE CLARIFICATION OF LIQUIDS (JUICES). *L. Linden, of Compayne Gardens, London. 161,755 (2695). January 28th, 1920.*

In apparatus for separating suspended matter from a liquid stream by successively subjecting it to abrupt upward, downward, and again upward deflexion with consequent changes of velocity in the neighbourhood of quiescent zones, means are provided for separately collecting and discharging from said zones the separated matter of different



specific gravities. The apparatus shown comprises a central tube *c* and concentric vessels *d*, *f*, *g*, of similar configuration and of such a size that liquid supplied through a pipe *a* to the tube *c* and overflowing into a discharge trough *g*³ flows intermediately through passages between the several vessels having a successively increasing cross-section. Vertical plates or rings *e*, *h*, *j*, are provided as baffles in the positions shown. Heavy matters settle into pockets *d*², *g*², of the vessels, *d*, *f*, and light impurities rise to the surface in the vessels *d*, *f*, and can be floated off at intervals through a trough *d*⁴ or troughs *d*⁶, *d*⁸. Separation can be aided by the supply of steam or other heated medium

through perforated pipes *q*, *r*, *s*, *s*¹, and of air through a pipe *s*², which is situated in the opening *d*³ between the vessels *d*, *f*, and has perforations directing the air into both vessels. The pipe *a* may deliver the liquid on to a perforated basket *p* containing a solid reagent. Lime in solution may be supplied to the pocket *d*² through a small central pipe *v*; while steam, water, or chemicals for cleansing may be directed along the bases of the vessels from perforated tube rings *t*, *t*¹, *t*².

Patents.

SEPARATING STARCH FROM GLUTEN. *Corn Products Refining Co., of New York.* 159,838 (7024). March 3rd, 1921; convention date, March 8th, 1920; abridged as open to inspection under Section 91 of the Act.

Water containing the starch and gluten in suspension is subjected to agitation and aeration for the production of a froth from which the starch is allowed to drain, while the glutenous froth is separated in troughs.

MACHINE FOR CUTTING PLATES AND BARS OF SUGAR INTO CUBES, ETC. *Soc. Anon. Raffinerie Tirlemontoise, Tirlemont, Belgium.* 159,899 (7589). March 9th, 1921; convention date, March 10th 1920; not yet accepted; abridged as open to inspection under Section 91 of the Act.

A feeding device for a sugar-cutting machine consists of two portions, of which one brings the sugar up to the cutters and the second moves it while it is being cut and regulates the size of the cut pieces.

COATING CONFECTIONERY. *A. Sonsthagen, of Leytonstone, London.* 158,993 (28,356). November 16th, 1919.

UNITED KINGDOM COMPLETE SPECIFICATIONS ACCEPTED.

HARVESTING CANE. *M. Wertheim.* 164,229 (14,170). May 25th, 1920.

SETTLING TANKS. *W. J. Mellersh-Jackson (Dorr Co.).* 164,645 (25,366). September 2nd, 1921.

FILTERS. *S. Löffler.* 163,252 (35,256). December 15th, 1920.

APPARATUS FOR SPECIFIC GRAVITY DETERMINATION. *C. W. Stancliffe.* 145,447 (16,544). July 15th, 1915.

EVAPORATORS. (1) *E. Josse and W. Gensecke.* 138,871 (3895). February 27th, 1915.
(2) *N. Testrup and Techno-Chemical Laboratories, Ltd.* 163,793 (5558). February 24th, 1920. (3) *F. Merz.* 164,525 (7778). March 16th, 1920.

PROCESS AND APPARATUS FOR TREATING LARGE QUANTITIES OF LIQUIDS WITH PURIFYING APPARATUS IN A CONTINUOUS MANNER. *A. J. H. Haddan (Naamloose Vennootschap Algemeene Norit Maatschappij).* 163,505 (5707). February 25th, 1920.

REFINING CHOCOLATE. *A. Sonsthagen.* 163,844 (7458). March 12th, 1920.

COATING CONFECTIONERY. (1) *R. F. Macfarlane.* 164,564 (9635). April 6th, 1920.
(2) *C. A. Fankhauser.* 157,973 (1746). January 13th, 1920.

MECHANISM FOR HANDLING COCOA NIBS. *E. C. R. Marks (National Equipment Co.).* 163,261 (7125). November 4th, 1919.

CENTRIFUGALS. (1) *S. S. Hepworth Co., and E. M. Mackintosh.* 145,900 (14,550); 143,903 (14,553). September 29th, 1916. (2) *O. Imray (W. Mauss).* 164,418 (3474). February 4th, 1920.

MANUFACTURE OF SYRUPS AND SUGARS. *F. Patterson.* 163,924 (16,322). June 19th, 1920.

PURIFICATION OF LACTOSE. *J. Tarroges, J. W. Roche, and G. Martin.* 163,937 (22,021). July 22nd, 1920.

FERMENTATION PROCESS FOR PRODUCING BUTYL ALCOHOL AND ACETONE. *C. Weizmann and G. A. Hamlyn.* 164,023 (9181). June 29th, 1916.

GLYCERIN PRODUCTION BY FERMENTATION. *A. T. Cocking and C. H. Lilly.* 164,034 (23,644). September 25th, 1919.

DISTILLING APPARATUS. (1) *N. H. Freeman.* 164,098 (5271). February 27th, 1920.
(2) *G. W. Ellis.* 164,407 (698). January 8th, 1920.

EXTRACTING MATERIALS. *Elektro-Osmose A.-G. (Graf Schwerin Ges.).* 146,453 (18,521). July 3rd, 1919.

MANUFACTURE OF SUGAR FROM WOOD, ETC. *A. Classen.* 164,329 (15,249). June 4th, 1920.

United States.

(Willet & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920. Tons.
Total Receipts January 1st to June 23rd		1,359,291	1,649,182
Deliveries		1,345,621	1,649,182
Meltings by Refiners		1,195,014	1,462,119
Exports of Refined		101,000	270,000
Importers' Stocks, June 23rd		23,722	none
Total Stocks, June 23rd		204,006	52,614
		1920.	1919.
Total Consumption for twelve months		4,084,672	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

	(Tons of 2,240 lbs.)	1918-19. Tons.	1919 20. Tons.	1920 21 Tons.
Exports		1,800,023	2,318,956	1,313,434
Stocks		1,192,732	661,762	1,322,313
		2,992,755	2,980,718	2,635,747
Local Consumption		47,000	39,700	53,000
Receipts at Ports to May 31st		3,039,755	3,020,418	2,688,747

Havana, May 31st, 1921

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SIX MONTHS ENDING JUNE 30TH, 1913, 1920, AND 1921.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	429,317	99,094	205,045	533	787	159
Raw	546,878	703,748	486,988	2,029	3,579	1,304
Molasses	75,508	46,397	38,889	181	1,858	345
	1,051,403	849,239	730,922	2,743	6,204	1,808
HOME CONSUMPTION.						
		1913. Tons.	1920. Tons.	1921. Tons.		
Refined		419,641	117,116	192,476		
Refined (in Bond) in the United Kingdom		355,358	385,762	403,464		
Raw		60,618	126,232	62,227		
Molasses		15,660	19,082	5,819		
Molasses, manufactured (in Bond) in United Kingdom ..		19,299	41,912	23,588		
Total		870,574	690,104	687,574		
Less Exports of British Refined		12,837	151	3,652		
		857,737	689,953	683,922		

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING JUNE 30TH.		SIX MONTHS ENDING JUNE 30TH.	
	1920 Tons.	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS.				
Germany	95	....	5,651	....
Netherlands .. . . .	....	....	....	595
Belgium .. . . .	....	....	....	....
France .. . . .	....	....	....	....
Czecho-Slovakia .. . . .	....	....	....	....
Java	7,698	22	8,087	21,854
Philippine Islands .. . . .	....	....	....	....
Cuba	68,951	13,837	458,288	111,365
Dutch Guiana .. . . .	....	33	30	721
Hayti and San Domingo .. . . .	....	....	....	....
Mexico .. . . .	....	....	....	....
Peru	1,932	3,852	22,954	54,610
Brazil	108	6,890	5,775	37,140
Mauritius	263	21,708	90,429	153,832
British India	5,464	....	12,211	615
Straits Settlements .. . . .	....	....	....	....
British West Indies, British Guiana & British Honduras	30,669	17,379	85,573	66,952
Other Countries	1,121	2,284	14,750	39,303
Total Raw Sugars.....	116,301	66,006	703,748	486,988
REFINED SUGARS.				
Germany .. . . .	....	....	126	1
Netherlands	16	9,130	1,059	51,313
Belgium	569	13	1,640	16,141
France	7	5	10	2,607
Czecho-Slovakia	6	....	102	138
Java .. . . .	....	....	5,012	104
United States of America	6,484	32,763	83,219	62,555
Argentine Republic .. . . .	....	....	....	....
Mauritius .. . . .	....	....	....	....
Other Countries	225	22,916	7,928	72,186
Total Refined Sugars ..	7,309	64,828	99,094	205,045
Molasses	7,758	4,153	46,397	38,889
Total Imports.....	131,368	134,987	849,239	730,922

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .. . . .	....	1	....	1
Netherlands .. . . .	....	140	2	1,402
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	35	104	141	711
Canada .. . . .	....	....	....	....
Other Countries .. . . .	....	243	9	1,538
	35	487	151	3,652
FOREIGN & COLONIAL SUGARS.				
Refined and Candy.....	5	70	767	159
Unrefined	2,338	776	3,579	1,304
Various Mixed in Bond....	....	....	....	....
Molasses	555	39	1,858	345
Total Exports	2,933	1,372	6,355	5,460

Weights calculated to the nearest ton.

Sugar Market Report.

Our last report was dated 4th June, 1921.

The weakness noted at that date progressed throughout the month, and values in all departments continued to shrink in no uncertain manner. Only during the past few days have there been any signs of resistance to the fall, when a revival of demand from the home trade has synchronized with better advices from abroad.

Present prices for refined are but a shade better than the lowest and are 5s. to 6s. per cwt. down on the month. 'Tates' London Granulated is quoted at 56s., No. 1 Cubes 60s spot, duty paid; Czecho-Slovak Superior Granulated 27s., ASP, etc., Cubes 29s. f.o.b. Hamburg; American Granulated, 27s. 3d. c.i.f. U.K. ports. It is still noticeable that interest is centred almost exclusively in parcels on the spot or for early arrival; the settlement of the coal-strike probably assists the demand for such near at hand lots, but greater confidence is needed to stimulate enquiry for later periods.

W.I. Crystallized on the spot are held at 44s. to 49s. for grocery descriptions; 39s. to 43s. for lower qualities, duty paid. Cuban 96° Centrifugals nominally 16s. 6d., Peru 96° about 15s., Brazil 80° Syrups 11s. per cwt., all c.i.f. U.K. In the Terminal Cane Sugar Market there are buyers of Oct./Dec. at 15s. 9d., this being a recovery of about 1s. 6d. per cwt. from the lowest price touched.

In the American market, the weight of unsold sugar continues to make itself felt and prevents any lasting firmness. Quotations c. & f. New York for 96 per cent. Centrifugals may be called 4c. to 4½c. for sugars going in free of duty, and 2½c. to 2¾c. per lb. for full duty lots. The consumption shows no sign of substantial increase, and for January/June is expected to total about the same as a year ago, viz., 2,380,000 tons; but, whereas the period last year saw eager buying at advancing prices and a tendency to stock up invisibles, the feature of the present is the rapid manner in which the sugar is being actually absorbed. Hence the figures for the second half of the year should make a more favourable comparison.

Latest Cuban statistics compare with previous years as follows:—

	1921.	1920.	1919.
Week's receipts to 2nd July ..	38,000 ..	36,235 ..	45,589 tons.
Total to 2nd July	2,925,000 ..	3,213,763 ..	3,317,645 ..
Total stock at 2nd July	1,415,000 ..	540,320 ..	1,135,231 ..
Centrals working	11 ..	13 ..	25

The total of the stocks held up country is not known, but it is difficult to see how the estimates of a crop of 3,900,000 tons are to be reached, even allowing liberally for this item. To complete that figure some 975,000 tons would have to be brought into sight from this date on, as against some 520,000 tons last year.

White Javas are lower at 13 guilders per picul f.o.b. second half July shipment, 12g. August and 11½g. September, these quotations being about a guilder above the lowest at which business has been done. There have been one or two periods of considerable activity in the demand for India, during which the Syndicate of Producers has made progress with the sale of its holdings; the unsold quantities are now estimated to have been reduced to about 400,000 tons Whites and 425,000 tons Browns and Muscovados. In addition there are probably some 150,000 tons still unsold in the hands of the independent mills. For India the quotations for Whites are to-day, August shipment 18s., Sept./Oct. 17s. 9d. c. & f. Calcutta; July shipment is scarce and not offered. Freight to U.K. having become dearer 19s. c.i.f. is now asked for August shipments.

Continental crop reports are generally favourable; Germany, Czecho-Slovakia and the Netherlands have had sufficient rains, but some parts of Franco report that more rain is needed. It is expected that the Italian Government will relinquish the control of sugar at an early date, and the increase in the coming crop will probably render further imports unnecessary.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
July 5th, 1921.

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✂ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Report of the Indian Sugar Committee.

Just as we go to press we are in receipt of a copy of the Report of the Indian Sugar Committee. As was to be expected, it is a weighty document and will long serve as a useful guide to the complex problem of the Indian sugar industry. The Report is compressed a good deal; but, even so, it covers about 400 folio pages of printed matter and contains a number of maps and is illustrated by 23 plates. A useful feature is a chapter upon the sugar industry in Java, which country the Committee visited in the course of their extensive touring. It will not be possible to discuss this report at length in the present issue, but one or two points may be noted. Among the most important of its proposals is the formation of a Sugar Board into which the Sugar Bureau will be merged, and on this Board there will be representatives of the cane growers, manufacturers and the sugar trade. One of the most important functions of the Board will be the general control of the policy of a proposed large Sugar Research Institute. This is to be erected in the eastern portion of the United Provinces in a tract with large areas under the indigenous Indian canes. It is proposed that the Institute will be modelled on the Java plan, with a large farm and small sugar school for training students in every branch of the industry: there will be three main sections, agricultural, chemical and engineering, each of which is to be under a competent director. The whole scheme is laid down on the broadest lines and will cost a great deal of money, but the importance of the industry is so great that a heavy outlay would be fully justified. The Report is divided into the following sections: Agricultural, Manufacture, the Industry, and various appendices; and we propose to deal with some of its features in our next issue.

The Tate-Lyle Refineries Amalgamation.

The most important event in the history of British refineries for many years past is undoubtedly the absorption by Messrs. HENRY TATE & SONS, Ltd., of the refining business carried on by Messrs. ABRAM LYLE & SONS, Ltd., which is in process of completion. A certain community of interests begotten by war-time restrictions has doubtless led these big London refining interests to combine and

thereby effect as it is hoped considerable economies in administration, in purchase of raw material and in distribution of the finished product. Whether this example of combination will be followed by others amongst the Liverpool and Greenock houses remains to be seen. But the establishment of anything in the nature of a sugar refining trust in this country is to be deprecated both from the point of view of the raw sugar producer and of the ultimate consumer, so any tendency in that direction will need to be watched.

The financial aspects of the deal are briefly as follows: The nominal capital of TATE & SONS is to be increased from £2,000,000 to £4,500,000, divided into £1,100,000 Preference and £3,400,000 Ordinary shares, of which total £4,412,000 has been issued. The purchase price to be paid to LYLE & SONS is £2,862,000, satisfied wholly in Preference and Ordinary shares, and in consideration of it TATE & SONS will get the £2,250,000 issued share capital of LYLE & SONS. But the ultimate effect of the exchange of shares between the two bodies of shareholders is that when the amalgamation is complete one half of the issued share capital of TATE & SONS (namely, 550,000 Preference and 1,656,000 Ordinary) will be held by the present Tate's shareholders, while the other half will be held by the existing LYLE shareholders, an arrangement which is said to be in accordance with the approximate values of the net assets of the two companies.

LYLE & SONS having hitherto been a private firm has never so far disclosed its earnings and dividends; but it may be presumed that these in the past have not been much if any behind Tate's, whose dividend during the last decade has averaged 23½ per cent. (rising in 1914 to 50 per cent. and falling in 1919 to 12½) apart from the payment in 1919 of a capital bonus of 100 per cent. There would therefore seem good grounds for supposing that under the new arrangements a very satisfactory rate of dividend will be secured on the revised capital, even if the dividends of the last ten years are not maintained.

Power Alcohol Legislation in the United Kingdom.

This year's Finance Bill in the House of Commons marks a step in the stages of Governmental conversion to the use duty-free of alcohol for power purposes in this country. Hitherto the preparation here of such spirit has been hedged with restrictions (such as the stipulation that not more than 500 gallons were to be distilled at one time) and the cost has worked out at not less than 2s. 2d. per gallon. These restrictions were devised originally to apply to the manufacture of potable spirit, and their unsuitability for the methylated variety was so patent that the Commissioners of Customs and Excise are now authorized to make new regulations which in effect will enable the rectification of low-grade alcohol imported from overseas to be undertaken in this country without let or hindrance and permit it to be freely stored and distributed. In addition, the taxation on such spirit is to be lightened, since the import duty of 5d. per proof gallon is to be abolished in the case of spirit produced within the British Empire. the duty on foreign produced spirit being maintained as before at 2s. 6d. per gallon. The rebate granted to home distillers of home-produced raw spirit is however raised from 3d. to 5d. per gallon, so that the effect of the new clauses of the Finance Bill is to give home-produced spirit an advantage of 5d. per gallon over British Colonial produced spirit, and to the latter an advantage of 2s. 6d. over the foreign produced commodity. All this advantage, by the way, is confined to the imports of low-grade spirit intended for the manufacture in this country of power and industrial alcohol; on any completed power alcohol the full Customs duty of £2 12s. 11d. (less 2s. 6d. preference for that from Imperial sources) is still apparently to be levied.

The effect of the new provisions would thus appear to be that the home distiller is to be prohibitively protected against the output of foreign distillers, and that as regards his raw material he is given some inducement (5d. per gallon) to use preferably home grown sources of supply. If he elects to import the raw spirit for distilling purposes he is given the choice of that from Empire sources entering duty free, or that from foreign sources on which a duty of 2s. 6d. per gallon is to be levied.

As Mr. F. I. SCARD points out on another page, the sources of supply at home are too restricted and too incapable of expansion to need serious consideration; and imported raw material will have to form the vast bulk of the power alcohol distiller's requirements. On the other hand, the preference now accorded to Empire low-grade spirits should if maintained do something to encourage production not only in our sugar Colonies but also in those regions where (as has lately been demonstrated in the articles in our pages on the production of "Natile") other refuse vegetation can be called into play to supply the distiller's raw material. These sources of supply once they are opened up are almost illimitable.

But in the meantime the intending users in the United Kingdom of this power alcohol point out that as the great bulk of the waste molasses spirit available at the present day for distillation purposes is of Cuban or Javan origin, the effect of the duty of 2s. 6d. per gallon levied on it is to make such power alcohol derived therefrom too expensive to compete with petrol at its present price. The benefits of the new legislation are thus admittedly little more than an aid to stimulating in our Empire a production of raw material that is at present only in its infancy.

Financing the Cuban Sugar Industry.

The Cuban Sugar Finance Commission formed some months ago to control the sale of the Cuban crop has, it appears, been hitherto hampered from the fact that a million and a quarter tons of sugar has remained outside the scope of its operations and has been entering the market independently. Now that practically all of this competing supply is sold, the Commission is expected to command the situation and exercise more effective control on the sales of Cuban raws.

But there is such a large amount of unsold Cuban sugar waiting for a market that it is feared it will not be disposed of in the ordinary course before the new crop sugar enters on the scene. To relieve this situation, therefore, a bold scheme of a Government bond issue has been put forward and has every chance of being carried into effect. The plan is to issue forty million dollars' worth of bonds guaranteed by the Cuban Government at 6 per cent. interest, payable within 20 years, and the interest secured by a tax of thirty cents to be levied on each bag of sugar made during the currency of the loan. With these funds a specially organized company under Government control, to be called the Sugar Industry of Cuba Company, will buy up about a million tons of the present surplus supplies of sugar, paying for them not in cash but in these bonds. This sugar would be disposed of as opportunity offered, not on the open market, and preferably to countries which are in need of sugar but can only offer deferred payment for their purchase. By this means the sugar manufacturers of Cuba would be placed in a position to fund their coming crop, while the competitive market relieved of the bulk of the surplus of the 1920-21 crop would be able to start operations on the 1921-22 one on a more natural basis of supply and demand.

As *Facts about Sugar* points out, this is a most significant and important development. The objection, that although this amount of sugar be withdrawn through its purchase by the Cuban Government it will still be in existence and must be marketed at some future date—does not hold seriously, for the reason that the plan makes it unnecessary to dispose of this sugar within any prescribed period of time, since payment of interest and redemption of the bonds would be provided for by a tax on future production, and the sugar could even be thrown into the sea without affecting their security.

But in all probability it will find a purchaser, especially if sold on deferred terms. The phenomenal drought in Europe which is stated to be playing havoc with this year's beet crop is bound to be a favourable factor. If as seems very probable the European beet campaign yields considerably less than was estimated, the deficit will tend to increase the demand for Cuban sugars in Europe. The great purpose of this loan scheme is to place the Cuban sugar industry once more on a footing of financial stability, and though cash sales at the current trend of prices will not make over-capitalized businesses a paying proposition once more, they will at least allow the funding of the coming crop to be more promptly undertaken and thereby oil the wheels of the industry; incidentally, they may expedite the settlement of numerous accounts for sugar machinery supplied in 1919 and 1920, for lack of which numerous engineering firms have been placed in positions of more or less severe financial strain.

The New American Sugar Tariff.

The new Fordney Tariff Bill—as it is called—is progressing through Congress and should soon be passed into law. It maintains the emergency sugar tariff passed earlier in the summer which fixes the tax according to the polariscope test; 96 test centrifugals emanating from Cuba are charged 1.60 cents per lb., and other foreign sugars pay 2 cents, the former thereby continuing to receive a 20 per cent. rebate.

Two new provisions appear in the Bill: a duty of 50 per cent. ad valorem on rare sugars used for scientific work; and a provision whereby United States refiners handling raw sugars produced in the domestic United States are to be allowed to import 2 lbs. of foreign raws for each lb. of home grown raws they refine, at a rebate of 25 per cent. from the prevailing tariff rate. As explained by the Ways and Means Committee of the House of Representatives, the former provision serves to protect an industry fostered during the war which is of importance to industry, medicine and science. The latter provision is aimed at encouraging domestic sugar production, by making it possible for domestic beet and cane factories to operate throughout the entire year, thus reducing production costs, spreading the overhead charges over the 12 months, and at the same time benefitting the consumer.

Another provision modifies the drawback clause by which the exporter of refined sugar made from imported raws is allowed to recover the duty on the full proportion of such raws in cases where the foreign sugar is mixed with sugar of domestic production, instead of as formerly only recovering the duty represented by the proportion of foreign sugar in the refined mixture. This concession increases the rebate by roughly 7 per cent.

The Kelham Beet Factory.

The First Annual Report with Balance Sheet (for the year ending March 31st last) of Home Grown Sugar Ltd., the owners of the Kelham estate, shows a balance on Profit and Loss Account of £1947, this being due to profits from the working of the estate and farm. This first year's trading is of course only a preliminary to the main purpose of getting the beet sugar factory erected and working during this Autumn.

The Report states that the farm has been managed in a very efficient manner and much good work has been done on it during the past two years. The main work of the year has however been the erection of the factory and the making of arrangements for the cultivation of the necessary supplies of beet this summer. The contract for the sugar plant, as already announced, was placed with a leading firm of French sugar machinery specialists who have supplied the plans for the whole scheme as a complete unit. British architects were appointed to adapt the plans and supervise the building operations for which British building contractors and British labour were engaged. In October when the factory hopes to enter on its first campaign, a French factory manager (M. HENRI THIERY) with specialist foremen will be in charge; but the rest of the labour will be British. Some 2300 acres of beet are being cultivated by farmers in the district, while the estate will have 200 acres of its own under cultivation. This area, the Report states, is expected to yield the maximum quantity which during the first year it was thought safe to have available to deal with; consequently many offers from farmers had to be refused.

On account of the extraordinary cost of labour and materials, additional capital to the extent of £200,000 is required to complete the scheme, and provide in all a working capital of £700,000. To secure this sum, arrangements have been made, as is known, for a First Mortgage of £75,000, and Parliament has sanctioned an advance by the Treasury of £125,000 on Second Mortgage. Sanction has also been given by the Government for the first payment of the guaranteed dividend of 5 per cent. upon the public capital of £250,000. Finally, it has to be recorded that owing to ill-health the EARL OF DENBIGH has unfortunately had to retire from the Board.

Those who are anxious to see this venture prove a success will undoubtedly regret that this further addition of capital has been found necessary. The factory has been erected at probably the most expensive time in the history of the building trade; how it is going to compete with pre-war establishments (not to mention those erected in coming years, which, while costing more than the pre-war scale will almost assuredly be built at a lower rate than the present one) remains to be seen; but in the light of other contemporary flotations abroad, it is hard to resist the belief that it will ultimately prove over-capitalized. In France the cost of a similar 600-ton sugar factory is reckoned at present at some 16 million francs, or roughly 40 per cent. of the capital required for Kelham, even though building in France is very much in the hands of Trusts. A factory of like capacity which was erected in France during the war, built partly of second hand machinery, is said to have cost a trifle over 3 million francs complete (as compared with the 32 million francs of Kelham) and yet after one short season's working at a loss has just shut down because the directors consider it is impossible to earn a profit and depreciation on the cost. If this instance is at all comparable, it does not suggest that the Kelham factory will find it easy to earn dividends on its much larger capital, especially since sugar is no longer selling at £50 and upwards per ton!

However, thanks to the Government support, there is little doubt that whatever the financial outcome of the experiment, the latter will be carried through sufficiently far to enable us to gauge the possibilities of the subject under normal circumstances and normal capital expenditure. If the earnings of this factory will not suffice in the end to pay the minimum dividend on that capital sum which in more settled times will be needed to build a similar factory, then indeed it will have to be assumed that a beet sugar industry in this country is not practical politics. But it will not necessarily be the first campaign that will decide the matter of earning ability since we fear this unprecedented summer drought will bring in its train undersized roots and to that extent spoil the results for this season.

A British Refinery adopts Oil Fuel.

In a recent number of the *Grocer and Oil Trade Review* mention is made of the fact that Messrs. FAIRRIE & Co., Ltd., the well-known Liverpool firm of sugar refiners, have been running their refinery on oil fuel since the middle of June last. They had a reserve of several thousand tons of coal before the miners stopped work on April 1st, and were able to keep their refinery running until the beginning of May to supply all their customers, and to accumulate sufficient stocks of refined sugar to meet all demands until the beginning of June. But as soon as they found their stock depleted so that they could no longer keep up their customary output of some 3000 tons of refined per week, they proceeded to install an oil fuel burning equipment on their boilers, and then re-started their refinery.

An order was placed on Thursday, June 2nd, with the Wallsend Slipway and Engineering Co., Ltd., for two of their low-pressure oil burning systems, and most of the material was delivered by Monday, June 6th. All pipework, oil storage tanks and means of receiving oil both by road and canal, were provided by Messrs. Fairrie & Co.'s engineers; and the boilers, which represent 9000 H.P., were lighted on June 12th. Great credit thus reflects on the manufacturers and engineers concerned for this speedy conversion, which is considered to establish a record. Incidentally, this oil fuel installation is said to be the biggest in Lancashire.

No difficulties have since been experienced in maintaining the necessary supplies of steam, and the Company has therefore decided to use oil permanently on part, if not all, of their immense boiler plant. This should make the refinery virtually independent in future of coal as the sole source of their power, and, should further trouble be experienced in the mining industry, Messrs. FAIRRIE will be in an advantageous position to carry on undisturbed.

With regard to our recent reference to the services rendered to West Indian agriculture by Sir JOHN HARRISON, C.M.G., we appear to have overlooked the merit due to other workers, and our attention has been drawn to this by a correspondent. This was, of course, not our intention, which was primarily to draw attention to the eminence of Sir John's long labours in the tropics and the appropriateness of the distinction conferred on him. With regard to the manurial practice in the Demerara canefields, the claims of the Colonial Company should not be overlooked, in that as the result of their earlier experiments, confirmed by Sir JOHN HARRISON, the suitability of ammonium sulphate and mineral phosphates was first demonstrated, and subsequently very generally adopted in British Guiana.¹

¹ See the *West India Committee Circular*, August 12th, 1913.

Fifty Years Ago.

From the "Sugar Cane," August, 1871.

Some particulars were given in this issue of our predecessor of a process of purifying raw sugar, by means of which "many of the difficulties and expenses attendant on refining are saved." It was the invention of L. J. F. MARGUERITE.¹ After drying the raw sugar, it was placed in a cylindrical apparatus provided with a perforated bottom similar in form to a char filter, and there washed with alcohol containing 1.5-3.0 per cent. of sulphurous, sulphuric, or hydrochloric acid. When the soluble impurities and colouring matters had thus been removed, the crystals were further washed with neutral alcohol, and finally steamed and dried. A better procedure was to remelt the crystals obtained after washing with the acidified alcohol, add calcium saccharate to neutralize the acid present, and reboil to grain. "Sugar thus prepared is of very beautiful quality," especially (it was added) if the raw sugar had been pulverized before washing with the acidified alcohol, in order thus to remove the colouring matter in the lamellae of the crystals.

LOUIS TREGRE, in an article reproduced from the *Louisiana Sugar Bowl*, emphasized the importance of getting rid of the mechanical impurities present in the juice as completely as possible before the addition of the lime and sulphurous acid for effecting the clarification proper. This removal of the "filth and impurities" was regarded as an important discovery, which if utilized would result in increasing the yield and improving the quality of the sugar obtained. However, details respecting the method of removing the insoluble impurities, and the amount of lime and sulphurous acid added, were not given in this article, which had been written pending the publication of a patent protecting the operation of the procedure suggested.

A "Rapid Method of estimating Glucose in Cane and Beet Sugar" was described by Dr. T. L. PHIPSON. To a warm solution containing 1 gm. of the raw sugar, 1.5 gm. of caustic potash was added, then a strong solution of copper sulphate drop by drop, as long as any cuprous oxide was thrown down, and until the solution above had become blue in colour. This precipitate was filtered off, washed with hot water, and calcined, and the amount of glucose present in the raw sugar calculated from the weight of residue, which was assumed to be CuO. This procedure was proposed as an alternative to the volumetric method in use in most laboratories in this country at that time.

Notice was published of the issue of a prospectus for the formation of a company "for developing the products of the sugar beet grown in the United Kingdom," the capital required being placed at £200,000. It was proposed to erect several factories in suitable agricultural districts, the capacity of each being about 20,000 tons per season, and the cost about £40,000. It was expected to realize a profit of 16½ per cent. On the list of directors appeared the well-esteemed names of Mr. GEORGE MARTINEAU and Mr. HENRY TATE.

Among other articles which were published in this issue were "Notes on Manuring in Ceylon," by Dr. J. C. SORTAIN; "Chinese Immigrants as Workers on Cane Plantations"; "The International Sugar Convention of 1864"; and a table showing degrees Baumé and Twaddle, and the corresponding specific gravity values.

¹ English Patent, 1254 of 1867.

The Sugar Industry in Soviet Russia.

(From a Correspondent.)

There is no sugar in Russia. Only a few lucky individuals who receive "privileged" rations sometimes get some. The mass of the population can only look back with regret to the time when one could buy any amount of sugar at 4d. per lb. The Soviet Government is doing its utmost to improve the productivity of the nationalized sugar industry, but so far without any positive result. The future outlook both for sugar beet growing and the soft sugar industry leaves little ground for optimism.

The Russian sugar industry has been gradually declining since the war. The output of raw sugar has decreased during the four years of war from 1,740,000 tons in 1914 to 914,000 tons in 1917. After a year, that is from the beginning of the Revolution, the fall in the output continued at an appalling rate. During the two following years the production of sugar decreased more than eleven times—in 1919 only 80,000 tons were produced. This was the year when the sugar industry area was the scene of civil war, and the failure of the sugar campaign may partly be explained by the latter. But the same thing occurred likewise in 1920, when no regular military operations were carried on in the sugar producing provinces. Even then only 69 per cent. of the minimum sugar production programme was carried out. According to the *Ekonomicheskaja Zhizn* (October 13th, 1920), the estimated output for the sugar season of 1920 was 131,000 tons, but the actual output (according to information from the same source, i.e., the issue for June 4th, 1921,) amounted only to 90,850 tons.

The programme for 1921 is somewhat wider. According to the *Ekonomicheskaja Zhizn* (July 4th), the area under sugar beet was estimated at 540,000 acres, as against 486,000 acres of last year. (In 1914 there were 1,891,900 acres under sugar beet, with an output of 163,000 tons of raw sugar). Moreover, there is not the slightest reason to think that even this amount, however inconsiderable it may be for the Russian sugar industry, will be produced. The state of the sugar industry so graphically described in the same issue of the *Ekonomicheskaja Zhizn* gives ample reason to doubt in the first place that the whole of the estimated sugar beet area will actually be planted, and secondly, that the factories will be able to produce the estimated amount of sugar.

Like all other industries, the sugar industry has been nationalized. The Chief Sugar Committee (*Glavsakhar*) is an enormous bureaucratic institution, superintending the whole sugar industry, but it is situated in Moscow, far from the sugar producing districts. The local Soviet authorities in these districts pay no attention either to the requirements of the sugar industry or to the demands of the *Glavsakhar*, and yet it is these very local commissars who have the right to dispose of all the necessary labour.

The *Ekonomicheskaja Zhizn* points out that the local Soviet authorities frequently deprive the sugar beet growers of their horses and grain, or do not provide them with the necessary seed. In the height of the beet sowing season the labourers are transferred from the beet plantations to other places and so on. Twenty-five per cent. of the work of the Chief Committee consists in settling disputes between the sugar factories and local institutions. The sugar beet plantations, confiscated from private owners at the time of the Revolution, are now partly owned by peasants or have been partly transformed into Soviet farms. The peasants cultivate very little beet, because the price at which they are bound to

The Sugar Industry in Soviet Russia.

deliver it to the Government is very low and does not cover the great amount of labour necessary for beet cultivation. On the Soviet farms the work is unsuccessful owing to the bureaucratism common to all Soviet institutions. There is also a shortage of labour. Although the sugar beet plantations are usually situated in the corn-growing provinces, the Soviet authorities are incapable of providing food for their labourers. There is a shortage of live stock and fertilizers. At the beginning of the Revolution the peasants looted or slaughtered the cattle, and only about 20-25 per cent. of the necessary amount is left; the quantity of manure does not exceed 8 per cent. of the actual need. So far there is no accurate information as to the area under cultivation. The *Ekonomicheskuiu Zhizn* makes only a general surmise that the sowing is proceeding normally, with the exception of the provinces of Tambov and Voronezh, where "the issue of the campaign causes some apprehension." In any case, the plantations sown cannot be expected to yield the expected crop. The fields were badly tilled, and the seed is old, which is particularly harmful in view of the drought. According to the Soviet Government programme, the above-mentioned quantity of sugar was to be produced at 150 sugar factories (as against 231 at work in 1914), but the state of these factories is such that there is no hope of the proposed output materializing. Many factories require to be thoroughly repaired, and there is also some difficulty in obtaining the technical appliances. The chief difficulty, however, is the question of labour and fuel. The principal cause of the shortage of labour is the lack of the necessaries of life, while as regards fuel the stock of coal has fallen to 12 per cent., and that of wood-fuel to 25 per cent. of the amount required. If the factories are to do their full work by December 1st, they must have about 100,000 tons of coal. But there is no hope that this amount of coal—which at the present rate of work in the Donetz collieries represents about 40 per cent. of the nett monthly output—will be delivered.

All the foregoing considerations give grounds for doubting whether the 1921 sugar programme will be fulfilled. But even if the Soviet Government did manage to produce 163,000 tons of raw sugar, this would be quite insignificant for Russia and would far from satisfy the demand of even half of the population.

In 1913 Russia exported 100,000 tons of sugar, whereas now the Soviet Government is buying the first thousand tons of sugar abroad. Yet, in order to satisfy the normal demand of the population, ten times that quantity would have to be purchased, and that, of course, is impossible.

At a meeting of the Imperial Conference, held in London during July, a resolution was passed recommending that a conference of representatives of the patent offices of His Majesty's Dominions should be held in London, at an early date, to consider the practicability of instituting a system of granting patents which shall be valid throughout the British Empire.

Considerable interest appears to have been roused by the description of Mr. Jos. Avrutik's continuous centrifugal machine for curing masseccutes, which was recently published.¹ Encouraging trials are said to have taken place in the Ingenio Rio Cauto, Oriente, Cuba, the material travelling from the top to the next lower stage, and out of the separator, causing a separation and rearrangement of the masseccuite (as claimed) in each stage. A continuous machine of a type which eliminates certain practical difficulties is a matter of great interest, by reason of the reduced labour, lower first cost of the centrifugal station, and decreased power consumption which would result, as compared with the ordinary machines. We hope later to publish details of Mr. Avrutik's further trials now taking place.

¹ *I.S.J.*, 1921, 300 and 324.

Power Alcohol in the United Kingdom.

By F. I. SCARD, F.I.C

The acceptance by the House of Commons of the amendment introducing into the new Finance Bill a clause whereby Colonial alcohol for denaturing and conversion into power alcohol can enter the United Kingdom free of duty, and at the same time enjoy a protection of two shillings and sixpence a proof gallon against alcohol for the same purpose from foreign countries is a substantial step towards the solution of the problem of whether or not an efficient and sufficiently cheap substitute for petrol can be thus found.

The surtax on this class of imported spirit is abolished; but its principle is however, maintained in another form in the excise grant of 5d. per proof gallon which is given to the home denaturer of spirit intended for power purposes. This is an increase of 2d. per proof gallon on the previous allowance, but carries with it the proviso that the alcohol so denatured must be distilled in this country. It will be remembered that the surtax was originally imposed ostensibly to compensate the home distiller for the cost and loss arising out of the incidence of excise regulations, disabilities from which, it was alleged, foreign spirit did not suffer to the same degree. This subject was fully gone into under the heading "A Protected Industry," in the *International Sugar Journal* of January, 1910, and it was then shown there was only justification for the surtax to a very small extent, the major portion of it being nothing more or less than a protection of the home distiller. This protection, therefore, still exists in the form of the 5d. per proof gallon allowance, but the wind is tempered to the shorn lamb by the two shillings and sixpence per proof gallon protection which the Colonial distiller is, in his turn, afforded against foreign competitors.

Before the introduction of the new Clause, foreign and Colonial spirit imported for conversion into power alcohol were treated alike. From the Customs' bond it had to be transferred to the bond of the denaturer, who, on delivering the prepared spirit for consumption would pay 2d. per proof gallon, the difference between the 5d. surtax and the 3d. excise allowance. Now, the imported alcohol is to go into the bond of the denaturer in the same way, but there is no tax or excise allowance, the latter only being given in respect of home-distilled spirit used for the purpose, while only foreign spirit is liable to taxation.

It thus follows, under the new conditions, that a Colonial maker of alcohol for power purposes, importing his own spirit would gain no special advantage from setting up as a producer of power alcohol in the United Kingdom, as he did under the old Finance Act, and would be subject to a disadvantage of 5d. a proof gallon, or over 8d. a bulk gallon, in comparison with manufacturers who used home-made alcohol for the purpose. The home denaturer importing spirit would also be in the same position, and the effect of the new Clause would seem to be to develop a power alcohol industry in this country with home produced alcohol as its basis. It is, however, now generally recognized that there are no products commercially available for the purpose in this country. Land is required for growing food stuffs, and those which are suitable for alcohol production are required for food purposes. Apart from other considerations, the cost of labour, cultivation, etc., would be prohibitive for the production of a material which has to compete with petrol which is a natural product, and only requires refining to render it utilizable. The consumption of petrol in the United Kingdom is very great, and the extent of it will be realized when it is considered that it would take upwards of 2500 square miles of

Power Alcohol in the United Kingdom.

sugar beet cultivation to supply the corresponding amount of power alcohol. An area of this dimension cannot be spared in this country for the purpose, apart from other considerations. Attention is therefore, necessarily, directed to the tropics for a supply of the raw material to produce the alcohol on the spot or in this country.

Perturbation as regards the possible failure of the petrol supply has now passed, to a great extent, away. There seems to be the same ready supply as before the war, and in comparison with the cost of other commodities, the price of petrol is not excessive. There would, therefore, be direct competition between petrol and power alcohol, and for the latter to gain a footing in the United Kingdom a lower cost of production is essential. This is only likely to be obtained when the raw material is what would be a waste product, if not utilized in some form or other. Everything points to molasses being the only source which has a chance of commercial success, especially as the home distiller importing molasses for the purpose would receive the 8d. per gallon bonus on his alcohol to which reference has been made above. Foreign molasses can enter the United Kingdom for the purpose of distillation free of duty, and this would give rise to a competition with Cuban molasses. When, however, it is considered that the substitution of power alcohol for petrol in the United Kingdom would require the molasses from 16,000,000 tons of cane sugar, the extent of the competition is not serious.

The present Finance Bill shows that the Government is still protecting the home distiller against his Colonial brother. The introduction of completed power alcohol is practically forbidden by the Customs' tariff, which inflicts the full spirit duty upon it. But at any rate, by penalizing foreign plain spirit, it gives the opportunity wanted of putting the whole matter to the test, and it is to be hoped the advantage will be taken of it.

The question of the method of denaturing is left to the decision of the Commissioners of Customs and Excise, together with regulations as to transport, handling, etc., and the issue of the regulations embodying these details will be looked to with interest.

The Royal Commission on the Sugar Supply.

Further Report on Operations to March 1921.

(Continued from page 382.)

GENERAL OBSERVATIONS.

"In our first Report we observed that at that time 'it would be premature to attempt to draw from (our proceedings) the lessons that may be derived from the novel experiment of the conduct under State Control of the whole business of providing for the supply of an article of food of large and general consumption.' Even now we do not feel that we are competent to do this dispassionately or exhaustively—but our experience suggests to us certain observations which it may be useful that we should place on record.

"In the first place, we may say that the wisdom of the Government in at once taking over in 1914 responsibility for the sugar supply was, in our opinion, fully proved in the sequel. We think it possible that, during the first two years of the war, the ordinary agencies of trade might have shown themselves equal to maintaining a reasonably sufficient supply of sugar for the country. But even had there been no failure in the supply of the commodity, the trading in it would have been difficult and precarious, and in consequence there would have been frequent

and violent fluctuations in prices, with heavy gains and heavy losses to traders, and with rapid variations in price to consumers, and on the whole a largely increased charge upon them. From 1916 to the end of the war we do not believe that, left to itself, the trade could have maintained a sufficient or an uninterrupted supply. The difficulties of transport and of exchange became so great that even the Commission, with all the assistance that the Ministry of Shipping and the London Exchange Committee were able to give, found it no easy matter to procure sugar enough to meet even the reduced consumption imposed on the community.

"But while we recognise that in the special circumstances, State management was a necessity, our experience does not lead us to think that State control is a desirable thing in itself in the region of trade in commodities. In the region of public utility services there is much that may be said for State or Municipal control. But in trade proper, the conditions are different and different principles apply. For successful trading abroad and in competition with other nations, there are needed enterprise, constant vigilance, quickness of decision, the ability to act with promptitude and a certain measure of secrecy, all qualifications which are difficult to combine, and which are apt to be quickly lost, in a public Department.

"One aspect of State control that has been specially impressed upon us is the difficulty of fixing limits to it, once it is introduced. It cannot be limited to one branch only of a trade, say to import alone and not to distribution; otherwise any advantage gained in the controlled branch is apt to be appropriated by the traders in other branches instead of redounding to the profit of the community at large. This suggests the reflection that the same objection might be raised to the control of one or more trades and not of all, seeing that between one trade and another there exists an interdependence hardly less than that between one branch and another of a particular trade.

"Another thing that struck us was that in managing a State controlled business only broad lines of policy can be followed, and that exceptional wants and special predilections must be largely ignored. We found that in the machinery for distributing sugar there had grown up intermediate agencies of various character which, though difficult to reconcile with strict economical principles, yet apparently conduced to the convenience and the profit of numerous customers, who by reason of special circumstances in their financial or geographical position preferred to use such agencies rather than work through the more direct and regular channels. So far as was possible we endeavoured to avoid interference with these agencies; but we fear that we were not able to do more than mitigate damage to their interests, and with permanent State agency they would probably disappear.

"Finally it may be observed that the experiment in State agency that our Commission represents, has been a very different thing from what permanent State control would be. We found in full operation and activity all the machinery and the skilled personnel that had been brought together for the carrying on of trade in sugar by private agency; and these we were able to a large extent to utilise in the conduct of our business, after incorporating in our own body and establishment such elements of them as were required for our purpose. With State agency as a permanent institution, such skilled body of persons outside the Government Department would be non-existent."

The Report was signed by H. W. PRIMROSE (*Chairman*), ROBT. PARK LYLE, JOSEPH W. TODD, G. E. MAY, CLAUDE H. LIDDELL, and BEN TILLET; and is dated April, 1921.

The Royal Commission on the Sugar Supply.

Table I.

PURCHASES OF RAW SUGAR (TONS).

I.—RAW SUGAR.

WESTERN HEMISPHERE.		1914-15.	1916.	1917.	1918.	1919.	1920.	1921.	TOTAL.
		TONS.	TONS.	TONS.	TONS.	TONS.	TONS.	TONS.	TONS.
Cuba .. .. .	..	450,907 ..	549,485 ..	780,598 ..	883,607 ..	577,632 ..	489,841 ..	100,000 ..	3,331,970
British West Indies .. .. .	..	72,170 ..	4,960 ..	66,756 ..	66,301 ..	61,653 ..	95,824 ..	— ..	367,664
Domingo .. .. .	..	3,459 ..	— ..	— ..	— ..	— ..	— ..	— ..	3,459
Costa Rica .. .. .	..	— ..	— ..	1,634 ..	— ..	— ..	— ..	— ..	1,634
Brazil .. .. .	..	1,491 ..	6,509 ..	4,076 ..	— ..	— ..	29,948 ..	— ..	42,024
Peru .. .. .	..	10,348 ..	43,420 ..	39,988 ..	40,538 ..	77,836 ..	88,876 ..	— ..	301,306
Brazil (low grade) .. .. .	..	— ..	— ..	— ..	5,173 ..	— ..	— ..	— ..	5,173
Peru (low grade) .. .. .	..	2,212 ..	— ..	— ..	3,568 ..	1,868 ..	— ..	— ..	7,668
Venezuela (low grade) .. .. .	..	— ..	— ..	— ..	565 ..	— ..	— ..	— ..	565
Europe .. .. .	..	14,632 ..	— ..	9,996 ..	— ..	— ..	20,820 ..	— ..	45,448
Total Western Hemisphere..	..	555,219 ..	604,374 ..	903,048 ..	1,000,072 ..	718,899 ..	725,309 ..	100,000 ..	4,606,911
EASTERN HEMISPHERE.									
Java .. .. .	..	474,740 ..	359,788 ..	284,823 ..	— ..	66,700 ..	370,725 ..	— ..	1,566,776
Fiji .. .. .	..	6,475 ..	— ..	— ..	— ..	— ..	— ..	— ..	6,475
Mozambique .. .. .	..	445 ..	— ..	1,937 ..	1,982 ..	1,082 ..	— ..	— ..	6,466
Mauritius (low grade) .. .. .	..	— ..	— ..	4,430 ..	13,351 ..	— ..	— ..	— ..	17,781
Total Eastern Hemisphere ..	..	481,670 ..	359,788 ..	291,190 ..	15,333 ..	67,782 ..	370,725 ..	— ..	1,586,488
Various .. .. .	..	76,719 ..	— ..	— ..	— ..	— ..	19,680 ..	— ..	96,399
Grand total .. .. .	..	1,113,608 ..	964,162 ..	1,194,238 ..	1,015,405 ..	786,671 ..	1,115,714 ..	100,000 ..	6,289,798

Table I.—Continued.

II.—WHITE SUGAR.

WESTERN HEMISPHERE.		1914-15.	1916	1917.	1918.	1919.	1920.	1921.	TOTAL.
		TONS.	TONS.	TONS.	TONS.	TONS.	TONS.	TONS.	TONS.
American and Canadian granulated		243,504	239,994	57,897	44,202	252,967	14,355	..	852,919
American and Canadian cube sugar.		16,934	..	..	..	..	..	..	16,934
Argentina		28,527	..	..	..	..	..	..	28,527
Peru		690	..	..	..	..	..	..	690
Costa Rica		696	..	..	..	..	..	..	696
British West Indies .. .. .		..	..	14,003	..	1,250	..	..	15,253
Russia		2,140	..	..	..	..	..	..	2,140
Spain.. .. .		486	..	..	..	..	..	..	486
European granulated.. .. .		28,322	..	9,849	3,000	15,699	..	..	56,870
European cube sugar		30,356	..	..	..	..	..	..	30,356
Total Western Hemisphere..		351,655	239,994	81,749	47,202	269,916	14,355	..	1,004,871
EASTERN HEMISPHERE.									
Java		284,994	218,812	75,161	..	224,138	..	..	803,105
Mauritius crystals.. .. .		316,104	..	120,012	122,624	120,091	227,075	..	905,906
Mauritius (soft) .. .. .		..	..	2,761	..	..	..	..	2,761
Penang		300	..	..	..	..	..	..	300
Australia		1,127	..	..	..	..	..	..	1,127
Mozambique		298	..	..	..	..	..	..	298
Hong Kong.. .. .		..	..	8,075	..	..	..	..	8,070
Total Eastern Hemisphere ..		602,823	218,812	206,094	122,624	344,229	227,075	..	1,721,567
Various.. .. .		..	..	..	..	7,174	5,934	..	13,108
Grand total.. .. .		954,478	458,806	287,753	169,826	621,319	247,364	..	2,739,546

The Royal Commission on the Sugar Supply.

Table I.—Continued.

III.—RÉSUMÉ OF PURCHASES: RAW AND WHITE.

	1914-15 TONS.	1916. TONS.	1917. TONS.	1918. TONS.	1919 TONS.	1920. TONS.	1921. TONS.	TOTAL. TONS.
Total Western Hemisphere	906,874 ..	844,368 ..	984,797 ..	1,047,274 ..	988,805 ..	739,664 ..	100,000 ..	5,611,782
Total Eastern Hemisphere.. . . .	1,084,493 ..	578,600 ..	497,194 ..	137,957 ..	412,011 ..	597,800 ..	— ..	3,308,055
Various	76,719 ..	— ..	— ..	— ..	7,174 ..	25,614 ..	— ..	109,607
Total	2,068,086 ..	1,422,968 ..	1,481,991 ..	1,185,231 ..	1,407,990 ..	1,363,078 ..	100,000 ..	9,029,344

IV.—PURCHASES FOR ACCOUNT OF ALLIES.

PURCHASED FOR	COUNTRY.	1916. TONS.	1917. TONS.	1918. TONS.	1919 TONS.	TOTAL. TONS.
France	America (granulated)	199,000 ..	204,100 ..	100,000 ..	— ..	503,100
	Cuba (raws)	78,070 ..	101,000 ..	100,000 ..	— ..	279,070
	Mauritius	158,478 ..	— ..	— ..	36,000 ..	194,478
	Various	3,588 ..	— ..	— ..	— ..	3,588
Italy	America (granulated)	9,900 ..	23,550 ..	16,000 ..	— ..	49,650
	Cuba	— ..	4,550 ..	5,800 ..	— ..	10,350
	Java	— ..	16,400 ..	4,450 ..	— ..	19,850
	West Indies	— ..	— ..	3,650 ..	— ..	3,650
Belgium	Japan	— ..	— ..	50 ..	— ..	50
	America (cubes).. ..	600 ..	1,154 ..	— ..	— ..	1,754
Greece	Java	— ..	— ..	12,500 ..	— ..	12,500
Total		449,636 ..	349,754 ..	242,650 ..	36,000 ..	1,078,040

Table II.

PURCHASES OF SUGAR.

(Cost in Shillings and Decimals per cwt., c.i.f.)

I.—RAWS.									
WESTERN HEMISPHERE.		1914-15.	1916	1917.	1918	1919.	1920.	1921.	
Cuba..	.. Basis 96° Pol.	19-195	21-761	26-936	24-610	30-360	65-690	24-870	
British West Indies	..	18-770	19-142	26-650	26-210	29-260	50-640		
Domingo..	..	19-709	—	—	—	—	—		
Costa Rica ..	..	—	—	26-884	—	—	—		
Venezuela (low grade)..	..	—	—	—	20-470	—	—		
Brazil ..	.. No basis	17-575	21-732	24-869	—	—	—		
Brazil (low grade)	.. Basis 96° Pol.	—	—	—	21-680	—	55-220		
Peru ..	.. No basis	19-211	21-251	24-047	24-330	24-970	49-320		
Peru (low grade)..	.. No basis	21-117	—	—	22-180	20-300	—		
Europe..	.. Basis 96° Pol.	18-847	—	36-710	—	—	58-580		
EASTERN HEMISPHERE.									
Java..	.. Basis 96° Pol.	17-572	20-100	19-522	—	24-120	78-750		
Fiji ..	..	18-466	—	—	—	—	—		
Mozambique ..	..	19-597	—	23-760	20-010	38-560	—		
Mauritius (low grade)..	.. No basis	—	—	16-580	15-380	—	—		
Various..	..	18-918	—	—	—	—	87-75		
II.—WHITE.									
WESTERN HEMISPHERE.		1914-15.	1916.	1917	1918.	1919.	1920.		
American and Canadian granulated	..	23-271	28-676	36-257	33-140	41-390	64-280		
American and Canadian cubes	..	26-260	—	—	—	—	—		
Argentina ..	..	19-633	—	—	—	—	—		
Peru ..	..	21-398	—	—	—	—	—		
Costa Rica ..	..	19-409	—	—	—	—	—		
British West Indies	..	—	—	30-077	—	95-000 L.P.	—		
Russia ..	..	19-335	—	—	—	—	—		
Spain..	..	23-456	—	—	—	—	—		
European granulated..	..	24-008	—	43-200	43-200	43-130	—		
European cubes	..	24-202	—	—	—	—	—		
EASTERN HEMISPHERE.									
Java ..	..	20-576	22-486	26-545	—	27-510	95-620		
Mauritius crystals	..	20-373	—	25-990	22-080	56-810	—		
Mauritius soft ..	..	—	—	29-000	—	—	—		
Penang ..	..	19-123	—	—	—	—	—		
Australia ..	..	21-205	—	—	—	—	—		
Mozambique ..	..	20-320	—	—	—	—	—		
Hong Kong..	..	—	—	30-990	—	—	—		
Various ..	..	—	—	—	—	29-690	71-360		

Meditations on Trapology.

The Rôle of the Steam Trap in the Sugar Factory.

By J. O. FRAZIER..

Sugar Engineer, New Orleans.

IV.

The primary actuating force for a majority of return steam traps is an alternating accumulation and release of approximately fixed weights of water. Accumulations bringing about the movement for discharge, and the release of weight restoring the chamber and valves to the re-filling position. Conforming with this, the chamber in which such weight accumulates becomes the primary moving part, communicating the proper motion to the controlling valves.

Probably the most commonly used of American return steam traps is that of the "tilting" type. Several of these are of very similar structure and appearance. The general method of operation, requirements in location and piping, and the economic value of service are practically the same for all types of return traps. A representative of the "tilting" type has been chosen for illustration in Fig. 7, with supplementary view in Fig. 8.

In the final analysis the return steam trap is in reality a pump, hence the valves become matters of special interest; these are the same in office and kind for all return traps. They consist of inlet water valves, swing checks *I-C*, *I-C* in the diagram, and outlet checks *O-C*, *O-C*, as also shown; Steam inlet valve-automatic *4*, and exhaust valve "vent" *3*, all in Fig. 7. The master steam supply valve, *ES*, is a hand manipulated one, and, unless for some long or necessary stoppage, remains wide open under normal working conditions. Steam equalizing valve *4*, and exhaust valve *3*, are automatically operated by the tilting movement of the chamber at their proper intervals.

There being no force for water discharge beyond the gravity head of the chamber above boiler water line, *B.W.L.*, and the equalization of pressure in the chamber with that in the boilers, it becomes necessary that full boiler pressure be available for such equalization. For this reason it is necessary that equalization steam for boiler feeding steam traps be taken at some point in the live steam system near the boilers, at least before some other source of steam consumption may have caused any drop in pressure.

A customary disposal of the displacement steam, which is very moderate in amount, is into the regular feed water collector of the factory. A better disposal, and for two reasons, is into the partial vacuum space of the last effect vessel—its heat belt. By such disposal all such steam is utilized along with the vapours coming from a preceding effect vessel, and the actual steam consumption of the return system is thus reduced to that of loss by heat radiation from the equipment. A very important additional advantage is also gained. Under venting into the atmospheric pressure, no lower pressure in the trap chamber is possible. By "venting" into the heat belt of a last effect vessel we gain the additional lowering of pressure due to the vacuum in such heat belt, which is equal to the vacuum in the liquor space of the next to last effect vessel. In general effect it adds from 5 to 8 lbs. "pull" to the force urging the water into the trap chamber, and the capacity is increased, accordingly, by the shorter time required for chamber filling.

Fig. 7 shows the application of a two-stage return trap system feeding the condensation from the steam belt of a first effect vessel into the boilers under

conditions that would defeat the operation of a single steam trap; two traps, nominally in series but not actually so, as descriptive detail will show.

In this figure, *A* is the steam or heat belt of a first effect vessel, whose calandria drains through the dotted line marked *d*, toward the first trap in the series *C-1*. This water is delivered by the first trap into reservoir-accumulator *D*. This reservoir has a vent into the main exhaust system, a section of which is shown as *E*, and from which steam for the multiple effect is taken. The water

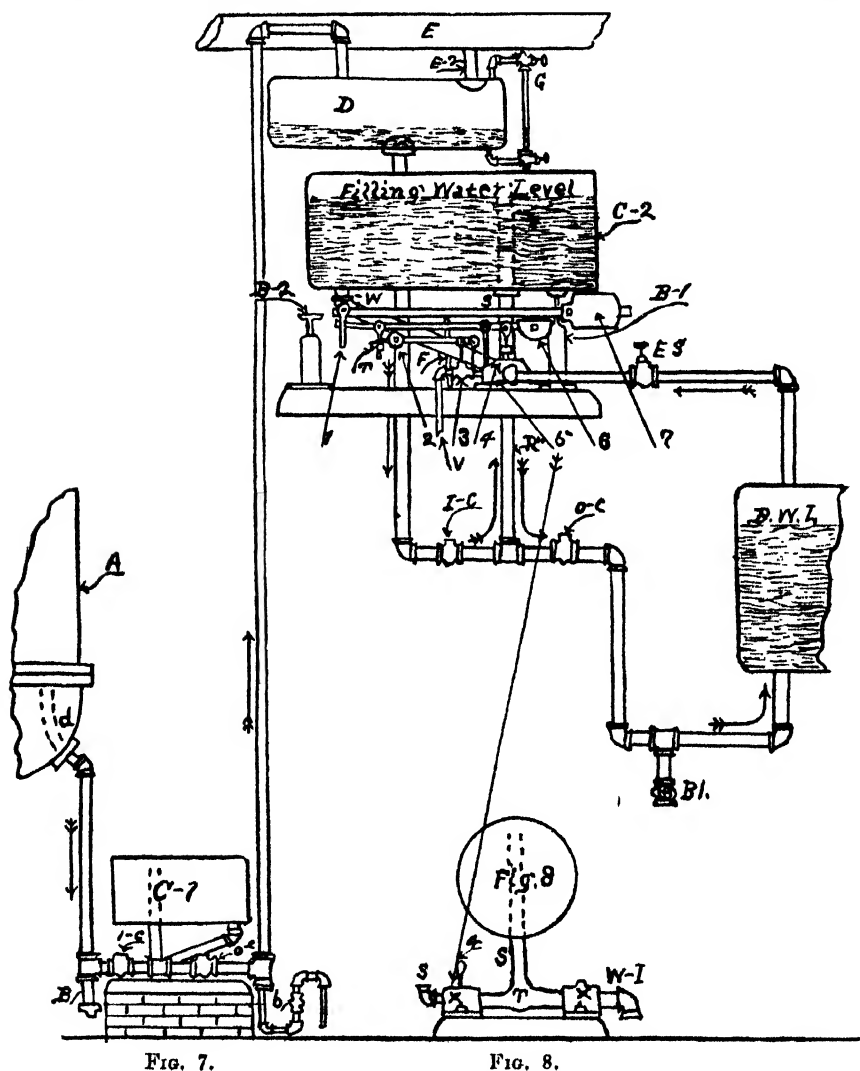


Fig. 7.

Fig. 8.

route follows the direction of the arrows into the boiler at the right and the same connexion as serves the blow-off valve *B1*. It will be noted that the pipe *R* has arrows pointing in both directions; the water inlet and outlet of the trap are through the same opening. Following up *R*", it passes through *W* on the inlet flow and a reversal of current on the discharge or outflow from the chamber *C-2*.

Meditations on Trapology.

In this figure the traps are exaggerated in size to better exhibit details, especially those of *C-2*. Lack of space makes impossible the showing in usual proportion. The venting of receiver *D* into the factory exhaust system makes a break in the continuity of flow, and especially of pressure between traps, hence the operation of the two is only nominally in series. The especial reason for such intermediate receiver is that no two steam traps could be made to "keep step" in their various movements. It will be understood that temperatures and pressures in the receiver *D*, in the exhaust system, and in calandria *A* are substantially the same.

The relative trap sizes required for the two stages of such service are roughly shown in the comparative sizes of chambers *C-1* and *C-2*. The equalizing steam for *C-1*, not delivering into the boilers, does not require the full boiler pressure like *C-2*, but may be taken from any part of the live steam system. The trap cycle is, of course, divided into filling and discharge periods. Any advantage that accelerates either of these is an equivalent gain in capacity. Having nominally boiler pressure in the tank of *C-1*, and discharging against, say, only 5 lbs. pressure in *D*, and *E*, it is easy to see that the discharge time may be very short. Having the same pressure, say boiler pressure, in the chamber of *C-2* for discharge, the only force available for the last is the "head" above the boiler water level, *B.W.L.* There is generally only a few feet head available in the average plant, and the general head sought is a minimum of about 4 ft. Extremes are known of from 10 to 12 ft., to a few inches. If *C-2* has, say, 6 ft. head, we have only something like 3 lbs. pressure at the discharge of *C-2*, whereas, with *C-1* the discharge pressure and resistance may be as 90 to 10 lbs. respectively. This indicates the necessity of having the second trap in such series several times as large as the first. The above in its relation to the boiler feeding trap emphasizes the importance of getting all the elevation above boiler water level that the situation makes possible. If other conditions were equal, and *C-2* had an elevation of 12 instead of 6 ft., its capacity would be very largely increased.

This brings us to the consideration of another factor in the possibility of feeding trap elevation, that of pressure available for trap filling. Take the particular situation shown in Fig. 7. If coils located as the calandria *A* or, in fact, any source of condensation, had, say, 50 lbs. pressure, the equivalent water column balance of such discharge would be nearly 100 ft. and would easily deliver its water, with a large surplus, into the chamber of a single feeding trap located as *C-2*. There must be an initial force for delivery of the quantity rate of water offered, but this is regardless of comparative levels between the condenser and the trap.

Taking Fig. 7 as a typical case of boiler feeding under the general conditions named, the following values approximately apply and indicate the necessity of the two-stage equipment for such installation. Applying some very customary elevations we may take the elevation of the bottom of calandria *A* at 9 ft., the boiler water level at 12 ft., and the bottom of chamber *C-2* at 16 ft. The total elevation from calandria to trap would be 7 ft. If direct delivery were desired into the upper trap from the calandria, and the very common pressure were used in the latter, the water column balance of such pressure, 5 lbs., would only be approximately 10 ft. This would only give an inlet to trap force of the equivalent of 3 ft. water head, which is far too small for the usual quantity delivered, hence the necessity of two-stage equipment for such service under the above very usual conditions. In such a situation the application of a "vent" into the vacuum of *C-2* would have a very positive and considerable value. If the vacuum in heat belt

chamber vented into have, say, 18 in., its "pull" at the trap inlet, would considerably more than double the inlet force by reason of the vacuum in the trap chamber in this case. Here is an instance of increasing the capacity of a boiler feeding trap by a method of piping equipment in addition to the increase above noted of increasing capacity by doubling a given elevation of the trap above the boiler water level. The actual increases above are variable and may reach as much as a 75 per cent. increased capacity. The vacuum "pull" shortens the filling time and the increased elevation the discharge time.

In Fig. 8 is shown an end view (partial) of *C-2*, with the end head removed to show the upward projection of the steam equalizing connection *S*, indicated in both figures by the dotted line. In order to prevent a water hammer commotion it is necessary that this equalizing steam be delivered on top of the water, shown in the shading. The chamber and its water load are supported on this steam pipe *S*, which is screwed into the two-way trunnion *T*. This *T* has separate passages for water and steam, and hollow projections into the trunnion boxes, *X, X*, (Fig. 8)—which trunnions are packed against the steam and water. In Fig. 8 is shown the steam equalizing connection at *s*, also the water connection, *W-1*, which latter in Fig. 7 is on the farther side.

In Fig. 7, at *B*, is shown a small trash well to catch any foreign substances, like red lead putty, for instance, that abounds in pan calandrias. At *b* is shown an automatic gravity drain, often of value in many cases. There is a small inverted vertical check valve near *b*, which, under usual working conditions, will be held closed. When no pressure is against its under side, it will fall open by gravity and drain accumulations of water not otherwise disposed of.

Referring to *C-2* in Fig. 7, the cycle of movement is as follows:—In the position shown the trap chamber is in its horizontal place of filling; the equalizing steam valve *4* is closed, and the vent or exhaust valve *3* is wide open, a condition of minimum pressure in the chamber. The shading shows the water accumulation very close to the filling line. The chamber, being hinged at an unbalanced point in its length as shown, is held to the horizontal when less than loaded, by the counter weight *7*. Near this water weight point the weight is overcome by the increased weight of the left hand end of the chamber. The first slight move tilting toward the left of the chamber immediately tends to throw a greater weight of water at that end and correspondingly lighten the right hand end. This incidental feature assists in assuring the positive dumping, or tilting movement.

As the chamber tilts toward the left, from its position on spring buffer *B-1* it lands on the buffer *B-2*, the extent of its travel. During this movement, the weight *7* has been overcome and ascends, swinging about the fulcrum *F*. The lever of weight *7* engages under a pin on the 45° elbow shown near *W*. There is a link *1* (through which the end of the lever of weight *6* passes) at the left, carrying a spool. The depression of the left hand of lever of weight *7* carries the link *1* downward with it, and depresses the left hand end of lever of weight *6*; this movement "pries" open the steam valve *4* to admit equalizing steam. The same movement allows the weight *2* to descend, and closes the exhaust or vent valve *3*. The chamber then is filled with water, with a pressure of steam on top equal to that of the boiler and the water flows by gravity into the boilers with a velocity due to the head of *C-2* above the boiler water level. When sufficient water has been released, the weight *7* overcomes that of the lighter chamber and the reverse movements take place. During these reverse movements the weight *6* has closed the steam valve *4*, and the tappet *T*, near the weight *2*, has lifted the

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vent valve 3 wide open for the release of displacement steam. This exhaust steam, as before noted, may discharge into the effect heat belt, the beginning of such connection being shown at *V*. The pressure in the receiver *D* is equalized with that of the factory exhaust system *E*, through the vent *E-2*. In the above showing a stop valve between the trap outlet and the boiler is used, but not shown on the diagram. This is to cut out any boiler that might not be in action, as also for determining the proportion of the feed for each boiler.

With a battery setting of several traps, there would of course be a main steam supply, main water distributing main and an exhaust main.

(To be continued.)

The Complete Applicability of the Modified Clerget Method.¹

By RICHARD F JACKSON and CLARA L. GILLIS.

In two recent articles C. A. BROWNE² has criticized the principles upon which the Clerget method of neutral polarization is based, and has concluded that the formulas and tables which we have computed for our general methods of analysis³ are incorrect.

In his second paper Dr. BROWNE calculated the error involved if the analysis is performed on a solution containing 15.5 grms. of sucrose in each of the solutions polarized. Since this is the concentration at which our direct determination of the negative constituent of the Clerget divisor was made, he has concluded that any deviation from proportionality in the direct polarization persists as an error in the completed analysis. This error he calculated to be about 0.11 per cent. At this particular concentration, our Method 3 is not subject to this criticism. Our first step was, therefore, to perform the analysis of pure sucrose at this concentration, using our Methods 2 and 3. Within the limits of accuracy of the measurements, identical analyses were obtained by the two methods.⁴ It thus became evident at the outset that our methods as originally proposed must be fundamentally correct.

In the light of this agreement of our determination by the two methods, the effect which Dr. BROWNE reports seemed to us so utterly improbable that we have made a great number of very careful measurements to verify or disprove it. While the differences noted by BROWNE appear considerable when multiplied to the normal concentration, the actual magnitudes involved in the observations are from 0.04 to 0.09°. It is thus evident that the most minute details of operation become important.

Our measurements were made with materials and apparatus which have been described in great detail in previous publications.⁵ Since the errors in the more dilute solution are greatly magnified by calculation to the normal polarization, we have, in these cases, made very numerous observations. As appears at once from Table 1, the rotary power of sucrose in the presence of 3.392 grms. of NH_4Cl is constant, regardless of its concentration.

Table 1.

ROTATION OF SUCROSE IN THE PRESENCE OF 3.392 GRMS. NH_4Cl .

	Grms.	Grms.	Grms.	Grms.	Grms.
Weight of Sucrose	5	13	20	20.79	26
Rotation calculated to 26 grms. ..	99.47	99.42	99.40	99.44	99.44

¹ Abridged. ² *I.S.J.*, 1921, 166, 276.

³ Bureau of Standards Scientific Paper No. 375; *I.S.J.*, 1920, 509, 570, 638.

⁴ *I.S.J.*, 1920, 640-641.

⁵ Bureau of Standards Scientific Paper Nos. 268 and 375; *I.S.J.*, 1917, 380; 1920, 509, 570, 638.

In order to obtain further corroboration of the truth of this conclusion, we have approached the question from a different angle. At each of a number of concentrations, two solutions were prepared containing the same weight of sucrose. One of these was made to volume with pure water. To the other, 3.392 grms. of NH_4Cl or 2.315 of NaCl was added before making to volume. These two solutions were then polarized side by side without particular reference to the zero point. This procedure constituted a differential method of obtaining the quantity sought, namely the depressive power of the salt at various concentrations of sucrose. The polarizations of the double normal weight were made in 100 mm. tubes; those of the 5 grm. solution in 400 mm. tubes. The results of these measurements from which now any scale errors are eliminated are assembled in Table 2. The depressions calculated to the normal concentration are seen to be constant.

Table 2.

DEPRESSIVE EFFECT OF NH_4Cl AND NaCl UPON SUCROSE BY THE DIFFERENTIAL METHOD (ROTATIONS CALCULATED TO 26 GRMS.).

	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.
Weight of Sucrose	5	13	15.5	18.75	26	52
Differential for 3.392 grms.						
NH_4Cl	0.55	0.53	—	0.56	0.57	0.59
Differential for 2.315 grms.						
NaCl	0.59	—	0.61	—	0.62	0.63

We are unable to interpret the results in Table II of Dr. Browne's second paper,¹ since we are not informed whether the observed rotations are corrected for the very considerable variation in the specific rotation of sucrose. However, let us for the moment accept his conclusion that a salt solution of constant composition depresses the rotation of sucrose by a nearly constant amount. If this is true for his 10 per cent. salt solution, it is also true for the solution containing 3.392 grms. of NH_4Cl in 81.35 grms. of water. This latter solution depresses the rotation of the normal sucrose solution to 99.40 (using Browne's data). If the ratio of salt to water is kept constant, it should also depress the rotation of 5 grms. of sucrose to 99.40 (calculated to 26 grms.). But, as we have shown above, the solution containing 5 grms. of sucrose contains only about 15 per cent. more water (or salt solution) than the normal solution. Dr. BROWNE, however, reports that 3.392 grms. of NH_4Cl depresses the rotation of 5 grms. of sucrose to 99.68 or —0.32, while we must conclude from his Table II that the addition of about 15 per cent. more, or about 0.5 grm. depresses it to 99.40 or an additional —0.28. In other words, he is faced with the dilemma of explaining why 3.391 grms. of NH_4Cl produces about the same depression as 0.5 grms. As a matter of fact, the difference between the depressive effect of a salt solution of constant percentage composition and one of constant volume composition is small, amounting in fifth normal solution to about 0.015°S in the actual reading. The obvious explanation is that his value 99.68 and all his values intermediate between the fifth normal and normal solutions must be incorrect.

Dr. BROWNE makes no mention of his precautions to meet the necessary requirement of an accurate scale calibration at points less than the 100° mark. There are, however, in his report two concentrations which are free from any doubt in regard to scale calibration because they were read at approximately the same scale division. These are the normal solution in a 200 mm. tube and the double normal solution in a 100 mm. tube. We are thus enabled to calculate the depression of the rotary power which his measurements show without

¹ I S.J., 1921, 277.

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the necessity of multiplying errors of observation or scale calibration. He has calculated this depression for the purpose of sustaining his main contention, but in so doing, he has overlooked the fact that the specific rotation of sucrose shows a very considerable change between the two concentrations of 26 and 52 grms. per 100 c.c. That he has made no allowance for this is evident from the facts that he has labelled his data "observed" and refers to them as the "relative polarizing power or positive constituent,"¹ thereby placing them in the same category as the other directly observed polarizations. In order to assure ourselves that this correction was not made, we performed the polarization and obtained a direct reading in essential agreement with his, thus definitely establishing the fact that the correction was overlooked.

A 100 c.c. solution containing 52 grms. of sugar, weighed in air with brass weights, has a density of 1.19486 and a composition of 43.5465 per cent. According to the formula of TOLLENS, the specific rotation of this solution is 66.285, according to that of NASINI and VILLAVECCHIA, it is 66.215.² The mean of these is 66.250. The specific rotation of 26 grms. of sucrose in 100 c.c. is 66.502. Thus, while 26 grms. in a 200 mm. tube polarizes 100°S, one containing 52 grms. polarizes in a 100 mm. tube but 99.62. It is from this latter polarization that the depressive power of the respective salts must be calculated for the double normal solution. We may now calculate what depression of polarization Dr. Browne's own measurements show between the very great change in concentration of sucrose from 26 to 52 grms.

Table 3.

CALCULATION OF DEPRESSION OF POLARIZATION IN THE PRESENCE OF NH_4Cl AND NaCl
FROM BROWNE'S MEASUREMENTS.

Concentration of Sucrose. Grms.		$[\alpha]_D^{20}$	Polarization calcu- lated to 26 grms. in pure water. Degrees S.	Browne's Polarization. Degrees S.	Browne's Depression. Degrees S.
(a) 3.392 grms. NH_4Cl .					
52	..	66.250	.. 99.62	.. 99.05	.. 0.57
26	..	66.502	.. 100.00	.. 99.40	.. 0.60
(b) 2.315 grms. NaCl .					
52	..	66.250	.. 99.62	.. 99.00	.. 0.62
26	..	66.502	.. 100.00	.. 99.35	.. 0.65
(c) 5 grms. NaCl .					
52	..	66.250	.. 99.62	.. 98.14	.. 1.48
39	..	66.417	.. 99.87	.. 98.42	.. 1.45
26	..	69.507	.. 100.00	.. 98.59	.. 1.42

It thus becomes evident from Table 3 that Browne's own measurements show a very nearly perfect constancy of the depressive effect of the respective salts in the wide ranges of concentration between 26 and 52 grms. per 100 c.c. when observed in the vicinity of the 100° point of the saccharimeter.

We have thus established by a direct determination, by a differential method, by a calculation from Dr. Browne's own polarizations of concentrated solutions, and by pointing out the obvious errors in his polarizations of dilute solutions, that the salt effect is constant even for concentrations with respect to both salt and sugar far beyond those concerned in our methods of analysis. Consequently,

¹ *I.S.J.*, 1921, 277.

² Browne's "Handbook of Sugar Analysis," page 176.

Browne's principal criticism, which had its major premise based upon a variation of the salt effect, becomes invalidated.

Dr. Browne's criticism is then extended to our Method 3. We are now asked to accept a formula for the variation of the rotation of invert sugar with dilution in the presence of a salt, which shows a very considerable variation of the salt effect for varying concentrations of sugar. In support of this formula, no experiments are cited, nor any description of the methods of obtaining the necessary data for deriving it. We are merely informed that this formula expresses the rotation "with sufficient accuracy."

On the other hand, our own experiments show that the invert polarization in the presence of ammonium chloride varies only as the specific rotation of invert sugar varies. In proof of this we cite the concordance of our analytical results in our previous paper¹ and the analyses in Tables 4 and 5 of the present paper. Moreover, if any such variation as Dr. BROWNE mentions occurs, it would also obtain with hydrochloric acid in the invert polarization, since the acid influences the rotation of invert sugar in the same manner as ammonium chloride. In all the many researches on acid inversion, including Dr. Browne's and our own, no variation other than that due to specific rotation has been found.

In corroboration of our claim that the modified Clerget method is of perfectly general application, we present in Table 4 the analyses of pure sucrose solutions in varying concentrations. In Table 5 we report the results of analyses of four sucrose-invert sugar mixtures in which our Methods 2 and 4 were employed. These particular mixtures were analysed by BROWNE, who used the unmodified Clerget method. The results of the analyses by this method were purposely shown by him to be grossly in error.² That these errors disappear in the modified Clerget method is at once apparent from Table 5.

Table 4.

ANALYSES OF SOLUTIONS OF PURE SUCROSE.

METHOD.	WEIGHT SUCROSE PER 100 C.C. GRAMS.	P - P'	T	CORRECTED DIVISOR.	SUCROSE FOUND, PER CENT.	SUCROSE TAKEN, PER CENT.	ERROR.
IV ..	25.0 ..	127.728 ..	20.23 ..	132.88 ..	96.12 ..	96.15 ..	- 0.03
IV ..	20.0 ..	102.000 ..	20.15 ..	132.68 ..	76.88 ..	76.92 ..	- 0.04
II ..	15.0 ..	76.862 ..	20.02 ..	133.22 ..	57.70 ..	57.69 ..	+ 0.01
III ..	10.0 ..	51.295 ..	20.02 ..	133.53 ..	38.42 ..	38.46 ..	- 0.04
II ..	6.4624 ..	33.020 ..	20.22 ..	132.68 ..	24.89 ..	24.86 ..	+ 0.03
III ..	5.0 ..	25.612 ..	20.01 ..	133.27 ..	19.22 ..	19.23 ..	- 0.01

Mean error - 0.01

Table 5.

ANALYSES OF SUCROSE—INVERT SUGAR MIXTURES.

METHOD.	IMPURITY, GRAMS.	P - P'	T	CORRECTED DIVISOR.	SUCROSE FOUND, PER CENT.	SUCROSE TAKEN, PER CENT.	ERROR.
II ..	2.74 ..	102.685 ..	19.95 ..	133.46 ..	76.946 ..	76.92 ..	+ 0.02
IV ..	5.48 ..	76.462 ..	19.99 ..	132.52 ..	57.70 ..	57.69 ..	+ 0.01
IV ..	8.21 ..	50.875 ..	20.09 ..	132.22 ..	38.48 ..	38.46 ..	+ 0.02
II ..	9.95 ..	25.462 ..	20.28 ..	132.56 ..	19.21 ..	19.23 ..	- 0.02

Mean error + 0.01

¹ *I.S.J.*, 1921, 217.

² We have reprinted his analyses from *B. S. Scientific Paper*, No. 375, page 192.

Recent Work in Cane Agriculture.

SUGAR CANE EXPERIMENTS IN THE LEEWARD ISLANDS. REPORTS ON EXPERIMENTS CONDUCTED IN ANTIGUA AND ST. KITTS IN THE SEASON 1918-9.
PART II. MANURIAL EXPERIMENTS. *Imperial Department of Agriculture for the West Indies, 1921.*

In the June number¹ of this Journal the general experiments on varieties were described, constituting Part I and the larger portion of these reports. The programme of the manurial experiments in the Leeward Islands has been interfered with because of the high cost of the materials, and no report has been issued since the results of the 1915-16² season were given. A summary is, however, printed of the results obtained during the period 1891-1916, which is of more than passing interest. The main conclusions with regard to the manurial requirements of sugar cane in these islands are as follows:—

In plant canes 20 tons of pen manure per acre are remunerative, but further additions to that quantity do not appear to be so. The addition of artificials to this basal dressing of pen manure is not apparently profitable. The limiting factors for fertility are an adequate supply of moisture in the soil and a sufficiency of humus; the latter is provided by the pen manure. Phosphatic manures appear to be of little effect as regards yield. Lime is beneficial in ameliorating heavy clays, but when applied in small doses to correct acidity does not appear to have had much effect, but this matter is still undecided. Molasses as manure gives an appreciable increase in yield.

In ratoons the general conclusions for plant canes hold with the following qualifications. Early dressings of quick-acting nitrogenous manures (at the rate of 40 lbs. nitrogen to the acre) stimulate the growth, if the rain conditions are normal. Molasses is of little value. Early intertillage is beneficial. Manures applied to plant canes or first ratoons show an effect in subsequent ratoon crops.

This series of experiments has been closed, and a new series has been opened in which the aim is to concentrate on the essential features brought out thus far, and also to secure more rapid results by an increased number of repetitions of the individual experiments. The manures applied in this new series may be grouped as follows:—(1) Quick-acting nitrogenous manures with the addition of potash and phosphate; (2) the same without the potash and phosphate; and (3) organic manures. Each set of experiments is repeated six times on each station in one-fortieth of an acre plots. In 1917-8 the scheme was applied to two estates in St. Kitts, but in one of these the results have not been published because of severe drought. In the other the following results were obtained. The highest yields were obtained by the application of quick-acting nitrogenous manures with the addition of potash and phosphate, but this was closely followed by the application of pen manure. In the absence of these additional manures, the quick-acting nitrogenous manures did not give any marked increase. The organic series of manures either depressed the yields or gave very slight increases. On these results the following provisional generalizations have been made for St. Kitts. The best results may be obtained, in the absence of pen manure, by the application of a complete manure containing 40 lbs. of nitrogen either as ammonium sulphate or nitrate of soda, 60 lbs. of K_2O in the form of potassium sulphate, and 40 lbs. of P_2O_5 as basic slag.

A further series of experiments, started in 1913, was continued. It consisted of plots in Antigua and St. Kitts with no manure, pen manure, no nitrogen,

¹ *I.S.J.*, 1921, p. 334.

² *I.S.J.*, 1917, pp. 380-3.

nitrogen as nitrolim and nitrate of lime with or without potash and phosphate. Dry weather again affected the results so that no appreciable increases were obtained.

Part II concludes with a statement of the relative acreages under the different varieties of sugar cane in Antigua and St. Kitts in 1917 and 1918. The following were planted over at least 500 acres in order of frequency: in Antigua, White Transparent, B 147, Sealy Seedling, B 6540 and B 4596; in St. Kitts only the first two, of which the largest area was under B 147.

AN ANNOTATED LIST OF SUGAR CANE VARIETIES. *F. S. Earle. Journal of the Department of Agriculture of Porto Rico, Vol. IV, No. 3, July, 1920.*

This paper of eighty pages is one of the most important recent advances in the literature on the classification of the sugar cane. As many as 1695 names have been got together with endless labour, and references are made to a copious bibliography. The author does not of course claim completeness, but rightly regards his paper as a basis for further work. He commences by a citation of cases where sugar cane countries, growing almost exclusively the Otaheite cane under various names, have experienced disaster because of the failure of that variety from the attacks of different pests and diseases—Réunion and Mauritius in 1840 and 1850, Brazil in 1860, Java after 1880, Porto Rico in 1872 and recently, the West Indies, Australia, South India, Hawaii, Natal and the Argentine. The mere unravelling of these various synonyms of the Otaheite cane is of itself a remarkable feat, and Dr. EARLE pays a well deserved tribute to the enormous amount of care taken in this and the other intricacies of the old nomenclature by Mr. NOEL DEERR who, added to his great experience in different sugar growing countries, has made the study of the literature of the subject an almost life-long one. In all of the cases cited salvation has only been obtained by the introduction of many other varieties and the selection from among them of more resistant kinds, at the same time suited to the local conditions of climate and treatment. With these examples, Dr. EARLE urges the claims of a better knowledge of the characters of the sugar cane, not only, as has too frequently been the case, of the sucrose content and milling qualities, but vigour of growth, habit and tillering power, resistance to diseases and pests, adaptability to various climates and soils, and the thousand morphological characters by which alone they can be accurately distinguished. Large collections of varieties have at various times and in various places been got together, but remarkably little has been done in their study and classification. The great opportunities thus offered for such study have been largely lost, e.g., of the fine collection of 413 varieties collected at the Field Station in East Java, in the fight of that country against *sereh*, for, beyond a few attempts chiefly with colour as the main characteristic, no real morphological study of the sugar cane was carried through, on which to base a classification on true taxonomic principles. Now that hosts of new seedlings have claimed the attention of workers at the various experimental stations, the fine old canes which were the result of ages of selection, and which few of the new seedlings approach in richness, are receiving less attention, although they furnish the material from which the new varieties are obtained. Dr. EARLE, by the way, notes that even now nine-tenths of the world's sugar is obtained from these old varieties, and makes a strong appeal that their study should be at once commenced on modern lines.

The following concluding remarks from this valuable paper will make the author's meaning sufficiently clear:—"If this list serves any useful purpose it will be in calling attention to the urgent need for careful taxonomic studies of all

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these old kinds in order to sift our synonymy and aid in the selection of useful kinds for breeding purposes and for further and more extended trials under varying conditions. Some of the earlier descriptions are very useful and serve to identify the variety in question with little chance for doubt. In most cases, however, they are practically valueless, being little more than notes on colour. Few of the older writers paid attention to bud characters. Among modern writers there are two whose work stands out pre-eminently—JESWIET in Java and BARBER in India. They have followed the usual methods of modern botanical taxonomy, with the result that cane varieties can be as certainly recognized from their descriptions as can flowering plants from a good botanical manual. FAWCETT in the Argentine has also done most excellent work along these same lines. If all those having access to collections of named varieties would give them a little critical study and publish descriptions along the lines followed by BARBER, JESWIET and FAWCETT, we would soon be in a position to clear up the cloud of doubt that has for so long hung over the use of cane-variety names."

PREMATURE GOING TO FLOWER OF THE SUGAR CANE. *H. de Grobert. Bull. de l'Association des Chimistes de France. 1920, 37, 279-285.*

The work of LABARTHE in Peru on this subject is described. This observer considers that the factor concerned is the disproportion between the amount of water absorbed by the roots and that transpired by the leaves. If from any cause the roots absorb more water than the leaves can dispose of, the tendency of the plant is towards premature flowering.¹ When then the plants in a field show signs of flagging and the leaves have adapted themselves to diminished transpiration, an irrigation will work for or against flowering according to the development of the roots. In poor soil where the roots are usually strongly developed and wide spreading they will tend to take up large quantities of water, with the result that flowering is hastened. If on the other hand the soil is rich, especially in nitrogenous material, the roots will be less extended and the amount of water taken up on irrigation will be less: the plant will go on growing and new leaves will be put out. On the question of the character of the juice in plants that have flowered LABARTHE appears to disagree with other observers, in that he has found that flowered plants have juice poorer in sucrose and richer in glucose: in most cases other observers have come to the conclusion that, once the flowering stage has set in, the juices remain more or less constant: growth however ceases and there is less of it, but the juice may even be richer in sucrose than in those plants which continue their growth uninterruptedly.

WINDROWING OF THE SUGAR CANE. *Scientific Reports of the Research Institute, Pusa, 1919-20. Report of the Imperial Agricultural Chemist, page 39.*

Fresh results of the work on this subject at Peshawar have been submitted for publication.² The investigation has been continued in the Pusa laboratory during the past season. Samples of cane were cut in pieces and the ends paraffined and these were placed in desiccators. Later examination showed that sucrose had not fallen in quantity, in fact had slightly risen. On wetting the pieces, however, it fell. This agrees with the Peshawar results, and tends to show that windrowing may be successfully carried out at Pusa where the temperature is much higher than in Peshawar. Moisture appears to be one of the most important factors involved. The laboratory samples were further examined under different

¹ *I.S.J.*, 1920, pp. 187-8 and 284-5. The influence of the character of the rainy season on the amount of flowering of the canes is discussed.

² For an account of previous work in windrowing at Peshawar, see *I.S.J.* 1920, pp. 369-370.

conditions and this examination tends to show that transformations of sucrose are due to agencies inside the cane and that enzymes are closely connected with it. This point is being further investigated.

BORERS IN SUGAR CANE, RICE, ETC. *T. Bainbrigge Fletcher, and G. C. Ghose.*
Third Entomological Meeting, Pusa. February, 1919. Vol. I, pp. 354-417,
with Plates 23-69.

This long and beautifully illustrated paper contains an account of current work on the borers affecting the Gramineae—cultivated, semi-wild, and wild—of which the sugar cane occupies the most prominent position. Any consideration of these pests must include alternative food plants, and so it has been found advisable to deal with the grass family as a whole. The observations and especially the laboratory work were carried out in the Research Institute at Pusa in Bihar.

The descriptions include all insects causing abrasions on the stem as well as those actually entering, as all such injuries are invariably followed to a greater or less degree by fungi (chiefly *Colletotrichum falcatum* causing red rot) which in most cases do the greater part of the damage. The beetles noted here are such as attack the sugar cane and the wild *Saccharums* which are abundant in the locality. Illuminating plates of life histories and diagrams of the mode of attack are given of termites, mole-cricket, and the more important beetle pests. The actual borers are listed under those attacking cultivated plants, fodder plants, semi-wild plants and wild grasses. Fourteen are mentioned as attacking sugar cane, and all but two of these have been fully named. It has been only possible to work out the life histories of those occurring in the canefields at Pusa, but this locality appears to be their happy hunting ground, so that few of them have not been fully investigated. Where it is known, their distribution outside the area is given and one or two important sugar cane pests occurring elsewhere are included, but there are very few references outside of this corner of India. The varieties dealt with belong to the following orders:—*Sesamia* (two), *Emmalocera*, *Scirpophaga* (two), *Procometis*, *Raphimetopus*, *Chilo*, *Diatraea* (four) and *Dasydes*. Of these *Emmalocera depressella* occurs only in sugar cane and may be described as the specific pest of that crop, causing greater damage than all the other borers put together. It has been reported from Bihar to Sind. Unlike other dead heart borers it works upwards but remains very low down, so that cutting out has been found harmful rather than otherwise. *Scirpophaga xanthogastrella*, a perfectly white moth (not met with in South India), on the other hand, works downwards, tunnels through the apical bud and emerges immediately below it: cutting out is therefore effective. *Chilo simplex* has many hosts and is really a pest of *juar* (*Andropogon Sorghum*). *Diatraea auricilia* attacks the young shoot and bores right down the stem and is difficult to remove. *Diatraea* sp. (lately named *Argyriotumida costalis* by Hampson) differs from the rest in attacking grown canes—a rather minor injury at Pusa. It has only been found in Eastern Bengal and Assam, and the life history has accordingly not as yet been worked out. The paper contains many details of these and other boring pests of the sugar cane.

The authors conclude with a section dealing with the damage caused to sugar cane by borers (pp. 395-409). That this is serious will appear from their estimate that only one in four shoots reaches maturity at Pusa, and these form the crop. A number of tables are added containing observations during 1917 and 1918 made at Pusa with different varieties, thick (tropical) and thin (indigenous Indian): it is not to be wondered at that the latter are much less injured at Pusa, for this locality is by no means suited to the growth of ordinary thick canes.

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The sets are liable to be eaten by termites. When the shoots appear they are attacked by termites, mole crickets, melolonthid grubs and other external borers. Of internal borers, *Scirpophaga* spp. and *Diatraea auricilia* are common at this stage and fungous diseases also begin to make their appearance. The first external symptom is the dead heart, and death or at any rate cessation of growth ensues. If not affected by fungus, new shoots appear around the base and many of these are attacked in turn, leading thus to a long struggle, largely dependent on the weather, in which only the survivors succeed in forming cane. If this stage is reached the shoot becomes immune to certain of the borers, but it is still liable to attack by *Scirpophaga* at the top, *Diatraea*, *Sesamia* and *Chilo* on the stem, and termites and *Emmalocera* at the roots. The latter cannot kill the plant but the following fungus can. Termites on the other hand can kill a grown plant and, if they do not, can afford entrance to a fungus which may, the result then being the drying out of the plant. The paper on the whole affords rather dismal reading from the point of view of sugar cane cultivation in this tract but, although this is the only tract which has received such detailed attention, it is certain that many parts of India suffer less from these and other sugar cane pests.

YELLOW STRIPE DISEASE INVESTIGATIONS (PROGRESS REPORT). *Journal of the Department of Agriculture of Porto Rico*. Vol. III, No. 4, October, 1919. (Issued in August, 1920).

This is a symposium in bulletin form on the mosaic disease in Porto Rico cane fields. It owes its inception to the efforts of Dr. F. S. EARLE who was commissioned by the United States Department of Agriculture to investigate the disease, and reached the island in August, 1918, shortly before Mr. J. A. STEVENSON'S departure. After a preliminary inspection, Dr. EARLE divided the subject into a number of projects in which the different workers in the island could interest themselves. The following are the ones which suggested themselves to him:—“(1) A field survey to determine the present extension of the disease. (2) Methods of eradication adapted to recent outbreaks or cases of partial infection. (3) Methods of cultivation best adapted to badly diseased fields. (4) Statistics of sugar production as affected by the disease. (5) Methods of natural or artificial infection. (6) Resistance and immunity—variety studies. (7) An ecological survey of the insect inhabitants of the cane fields with special search for possible carriers of the disease. (8) Cage experiments with insects suspected as disease carriers. (9) Morphological, histological, and cytological studies of diseased cane. (10) Studies on the nature of the disease and search for a causal organism. (11) Chemical studies of diseased as compared with healthy cane. (12) Soil studies: effects on the disease of different soils, soil sterilization, special fertilizers and their applications. (13) Relationship with other similar diseases: a comparative study of the mosaic diseases.” The progress along these various lines of enquiry is briefly stated by Professor EARLE in the first paper of the bulletin and, as might be expected, it has been unequal (some of the questions are much more difficult than others) but real progress is shown in many directions. No attempt is here made to indicate the relative value of the work done, nor would it be possible to do so in a short reference. In order that other workers may know of the contents in case they have not received a copy of the bulletin, the list of papers printed is subjoined:—

1. The year's experience with sugar cane mosaic or yellow-stripe disease.
F. S. Earle.

2. The mottling disease of cane and the sugar production of Porto Rico.
C. A. Figueroa.

3. The absorption spectrum of the chlorophyll in yellow-striped sugar cane. *E. D. Colon.*
4. Has yellow stripe or mottling disease any effect on the sugar content of cane juice? *F. A. Lopez Dominguez.*
5. Infection and nature of the yellow-stripe disease of cane (mosaic, mottling, etc.). *J. Matz.*
6. Insects and mottling disease. *E. Graywood Smyth.*
7. An annotated bibliography of Porto Rican cane insects. *E. Graywood Smyth.*
8. List of the insect and mite pests of sugar cane in Porto Rico. *E. Graywood Smyth.*

These papers are some of them peculiarly interesting and should be carefully studied by all who are interested in this baffling disease. For even when it is possible in Porto Rico or elsewhere strictly to control its incidence there is much that remains to be explained as to its mode of operation and causes in different circumstances.

FUNGI AND CANE GERMINATION. RESULTS OF EXPERIMENTS AT THE LOUISIANA UNIVERSITY EXPERIMENT STATION. *C. W. Edgerton and C. C. Moreland.*
Sugar, Jan., 1921, pp. 16-17.

Cane which has lain in the ground during the whole winter is always more or less infected by bacteria and fungi. The sets which do not germinate are always discoloured inside—brown, red, black, yellow or grey. Outside, the stalks are frequently shrunken and show fruiting pustules. The more important fungi are *Colletotrichum falcatum*, *Melanconium sacchari*, *Gnomonia iliaii*, *Marasmius plicatus*, *Thielaviopsis paradoxa*, two or more species of *Fusarium* and one of *Scopularia*, but besides these there are a large number of less important ones. The behaviour of these fungi is described briefly, and it is to be noted that not only their relative abundance but also certain of their characters present differences in Louisiana from their usual behaviour in the tropics. The germination of the sets is much lower than in the tropics, averaging only 20 per cent., therefore heavy planting is necessary. The buds on the upper parts of the canes do not grow so well as those on the lower, presumably owing to the softer and less resistant tissues there.

The following are notes on these fungi, collected during the past ten years in the fields and in laboratory experiments:—

Colletotrichum falcatum. This is one of the chief fungi causing seed deterioration in Louisiana. Entrance into the grown stem is usually obtained through borer holes or other injuries, as the rind is resistant unless young and tender. The fungus is internal and cannot be detected without splitting open the cane, which shows a characteristic white spot in the red tissue: this is regarded as conclusive evidence of its presence. The colour, however, is frequently masked by that caused by other fungi. In the sets the fibrovascular bundles are not so often coloured red as in the stems: entry is obtained through the young root eyes which are blackened; the cut ends are however not usually attacked because of the fermentation set up by various yeasts, thus forming an unfavourable medium for the development of the fungus. In Louisiana, lastly, there is no evidence that the fungus passes up the stem from a diseased set. It is extremely widely distributed, and to obtain a culture it is usually sufficient to cut up any bit of cane which has lain in the ground during the winter. Infection and development are more rapid in cut canes than in growing ones. Germination is decreased 50 per cent. in inoculated sets, as against healthy ones.

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Marasmius plicatus and *Gnomonia iliau*, causing root rot and stem rot respectively in grown canes, are present in the seed cane, but do not appear to reduce germination. On the other hand, they pass up the stem from diseased sets.

Melanconium sacchari is, as might be expected, very abundant in deteriorating seed cane, but does not appear to decrease the percentage of germination.

Thielaviopsis paradoxa is one of the most serious diseases of seed cane in the tropics, entering wounds or the cut surfaces and rapidly spreading throughout the set. It turns the affected region dark in colour, frequently forming a black pipe in the centre, and a blackish colour is always a suspicious sign. This fungus is very sparingly present in Louisiana, and does not seem to be responsible for much deterioration.

Fusarium in several species is present and very common in Louisiana seed cane. There are two chief kinds, the purple and the white, and the latter is the more important. It is present in almost every piece of seed cane, but can only be detected in the laboratory.

Scopularia is very abundant, but apparently is of little importance.

The optimum for growth of these fungi is 27°C., but in the normal temperature of the fields in winter growth is very slow. Treatment with formaldehyde and corrosive sublimate has given very encouraging results, the best having been obtained on a plot treated with the latter, where the tonnage at crop time was increased by 50 per cent.

C. A. B.

The Comparative Values of Decolorizing Carbons.

By A. B. BRADLEY.

In the March number of this Journal appeared a paper under the above title by Mr. F. E. THOMAS,¹ which the present writer has read with much interest. It will be readily admitted by everyone working on vegetable decolorizing carbons that the time has now arrived when a standard method should be devised, and a standard carbon adopted, for comparing the various commercial decolorizing carbons now in use, so that the results obtained by the many workers may in future be co-ordinated, and no longer appear contradictory, as is often at present the case. It is perfectly true, as Mr. THOMAS states, that many conflicting statements have been made in papers dealing with this subject, but we cannot agree that as a result "a lot of time has been wasted in argument between workers in different parts of the world." When it is remembered that the vegetable decolorizing carbon industry is even now only in its "regenerated infancy," it is only to be expected that workers should have attacked the problem from the various view-points, and gathered as much information on the subject as they could. The time has now come to separate the chaff from such a mass of results and gather in the fruits of research.

Perhaps, even now, it is hardly possible to adopt any particular carbon as a standard, for at the rate at which we are advancing, to-morrow may see the one selected left far down the scale by some new commercial product, either by reason of increased efficiency and perhaps enhanced rate of filtration, or by reason of increased efficiency coupled with increased life. In other words, a new carbon of a more stable structure may at any time be produced. When it is remembered that samples of "tremendous efficiency" (compared with present commercial

¹ I.S.J., 1921, 162.

products) can be readily made in the laboratory, and can even now be produced commercially *at a price*, there seems to be no reason why such a superior carbon may not appear at any time as a rival to the best at the moment in use. Considering also the vast strides that have been made during the past ten years, and knowing the direction in which some chemists and chemical engineers are working, it seems fairly certain to predict that such products will appear in the near future, and probably at such a price that regeneration and reburning may be entirely obviated.

We appear at any rate to have advanced to that point at which some standard method for comparison is necessary, although only a provisional measure may be adopted. We are therefore strongly in favour of Mr. Thomas' suggestion of a discussion between the many workers on vegetable decolorizing carbons, or the users of these preparations, in order that some standard method be adopted for stating their merits in relation to some standard. It must be remembered, however, that the various efficiencies found by any method using sugar liquor will only hold good in the sugar industry, since it is possible for two or more carbons to reverse their positions of efficiency according to the various technical purposes for which they are to be employed. A study of the "factors of efficiency" of several carbons for a number of different purposes would be distinctly interesting, and perhaps somewhat puzzling.

There are in Mr. Thomas' paper several points with which the writer cannot agree. In the first place, Mr. THOMAS is not in favour of the idea of measuring the "colour removed" by means of tintometers or colorimeters, as such methods give rise to errors both "personal and scientific"; so that, having carried out his suggested method of comparison, we are left to wonder how we are to determine or measure the effects produced. We are able to follow Mr. Thomas' objection to comparing solutions of high colour content with those of low colour value; but even these errors are, we think, less than those which will result if he carries out his verbal suggestion to the writer and compares his final solutions in Nessler tubes, a very primitive colorimetric method. Such a method will give no idea how much colour has been removed by either the standard or carbon under examination. Even granted that the comparison of more or less equal-coloured syrups will give a greater degree of accuracy than that of syrups showing wide variation, we would strongly urge that a standard tintometer or colorimeter be adopted by all workers, no matter which carbon be taken for standard. We suggest that perhaps the Hess-Ivos tint-photometer used by Dr. ZERBAN and other workers would be found the most suitable for this purpose. This is the first point which should be decided upon.

The strength and nature of the solution to be employed for the decolorizing tests should next be discussed, so that a solution of a common strength be used by all workers. Dr. ZERBAN, for instance, uses a very dilute solution of final molasses. We have always used a 50 per cent. raw cane sugar solution; others use aniline colours or caramel solutions. We have shown¹ that with a constant amount of colour present, but with an increasing concentration of sugar, the decolorizing efficiency of a carbon decreases rapidly, so that with the same carbon the results obtained by workers with dilute solutions may be much better than those found by others using more concentrated solutions. We would suggest, as Mr. THOMAS has proposed, that it would be much more desirable to adopt a 50 per cent. solution of a raw cane sugar, this being about the greatest concentration used in factory practice. If this were done and decolorizing values were estimated on

¹ *I.S.J.*, 1920, 52.

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these lines (even if sugar solutions of less concentration were treated in the sugar-house) the results so obtained would be on the favourable side for practice, whereas if dilute solutions were adopted for testing and then concentrated solutions for manufacturing, the results would naturally be very disappointing.¹

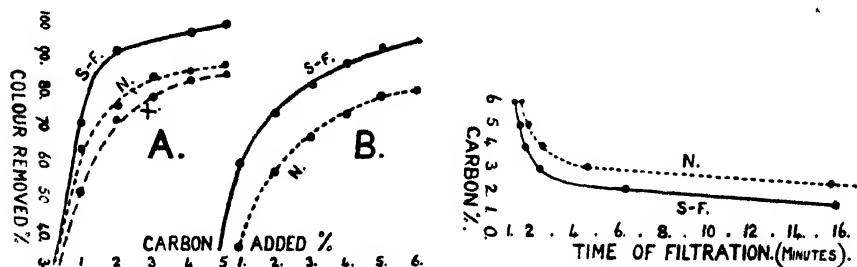
Another important point to discuss is the adoption of a "standard carbon." Mr. THOMAS suggests that "ZERBAN, BRADLEY, and others be followed in adopting 'Norit' as the standard." The present writer has never advocated the use of "Norit" as a standard, or even compared other carbons to it, but has always sought to make the most efficient sample at hand his standard. He is quite willing to adopt "Norit," or any other carbon as a standard; but, for reasons which will be stated, he is not in favour of "Norit" as a standard, and recommends that the commercial carbon which, at the moment gives the greatest decolorizing effect on a 50 per cent. raw cane sugar solution, should be employed for this purpose. It is certain, no matter what carbon be adopted, that manufacturers will strive to produce decolorizing carbons giving efficiencies greater than the standard. If we adopt, therefore, a carbon which is at the moment not in the premier position, we shall very soon have to revise our standard, and this will again lead to much confusion.

Let us examine the method proposed by Mr. THOMAS, taking "Norit" as the standard, and compare two carbons, one of which is superior and the other inferior. A 50 per cent. solution of Jamaica raw cane sugar was treated with 5 per cent. of Norit (on the weight of sugar taken), the amounts of the other carbons being varied in order to obtain more or less comparable decolorizing effects. The carbon superior to the standard when tested in this way was "Super-Filtchar," and that which was inferior we will call "X." With 5 per cent. of the standard carbon and Jamaica raw sugar liquor, a decolorizing effect equal to a removal of 86 per cent. of the total colouring matters present was obtained. Using the same syrup, 1 to 5 per cent. of the two carbons under examination were added. It may be mentioned that by Mr. Thomas' method we should not have known the amount of colour removed by 5 per cent. of the standard; but in our experiments this was estimated by the tintometer. About 1.6 per cent. of "Filtchar" produced the same decolorizing effect as 5 per cent. of the standard, whereas 6.6 per cent. of "X" carbon was required. Here we have the "factor of efficiency" proposed by Mr. THOMAS, who says, "the sugar refiner requires to know just how much of each carbon will be required to do the same work as 5 per cent. of standard." This may be perfectly true if the standard carbon is that which gives the greatest decolorizing effect, otherwise we are inclined to think sugar refiners would much prefer to use 5 per cent. of carbons giving decolorizing effects greater than standard and so obtain lighter syrups rather than cut down the amount of carbon to be used in order to obtain a less decolorizing effect or that equal to 5 per cent. of standard.

Further, Mr. THOMAS suggests that the amount of the standard used may be varied to meet the requirements of various carbons adding from $2\frac{1}{2}$ to $7\frac{1}{2}$ per cent.

¹ The following experiment illustrates this quite well:—A ton of raw Jamaica sugar was dissolved with a ton of water and treated with 5 per cent. (112 lb.) of Norit and pressed out. Next one ton of the same raw sugar was thoroughly washed in the centrifuge with water and steam, washing off roughly 30 per cent. The washings were now diluted with sufficient water to make one ton. This diluted solution was treated with 112 lbs. of Norit, and pressed out. To the norited washings was now added the thoroughly washed sugar (approximately 16 cwt.), and dissolved. The solution obtained in this manner was found to be very much lighter in colour than that obtained by direct treatment of the 50 per cent. solution, although admittedly it was not so bright and contained bag fibre.

instead of 5 per cent. The decolorizing effects, produced by the successive treatments with 1 to 5 per cent. of "Super-Filtchar," and "X" carbon, have been plotted as curves, together with the values found with similar percentages of the standard carbon. *A* represents the values obtained with raw Jamaica sugar, and *B* those obtained with raw Barbados sugar.¹ It will be seen from *A* that about



1.6 per cent. of "Super-Filtchar" is required to do the same amount of work as 5 per cent. of the standard, that is, the removal of 86 per cent. of the total colouring matters present, giving an efficiency of roughly 3 to 1 in favour of "Super-Filtchar." In the case of "X" 6.6 per cent. is required giving an efficiency of roughly 1.3 to 1 in favour of the standard. Supposing now we varied the amount of the standard and used 7½ per cent., we find that about 1.8 per cent. only of "Super-Filtchar" will be required, thus immediately altering our efficiency in the proportion of 4 to 1 in favour of "Super-Filtchar," whereas 7½ per cent. of "X" will be practically equivalent to 7½ per cent. of standard. If, on the other hand, only 2½ per cent. of the standard had been used, about 1.2 per cent. of "Super-Filtchar" would be required, giving an efficiency of about 2 to 1 in favour of "Super-Filtchar." With "X" carbon, 4.2 per cent. will be required, giving an efficiency of 1.6 to 1 in favour of the standard. This, we think, should show the undesirability of altering the amount of standard to be used within the limits 2½ per cent. to 7½ per cent. if the results are for comparison, as this may cause confusion.

Further, having seen from *A* that 1.6 per cent. of "Super-Filtchar" is equal to 5 per cent. of standard, let us, for demonstration only, assume that the top curve ("Super-Filtchar") is our standard and that the lower curves are to be compared to it. If 2½ per cent. of standard ("Super-Filtchar") be taken and "Norit" be compared with it, we find that the proportion of 2 to 1 in favour of our new standard is again altered to possibly 10 to 1. If 5 per cent. of this standard were used it is also quite possible that a comparison could not be made, in that even if a very high percentage of the lower efficiency carbons were used they would not give decolorizing effects equal to that produced by 5 per cent. of "Super Filtchar." The alteration in the relative efficiencies of different carbons

¹ This has been added to show that different raw sugars will give different curves of efficiency but the general order will remain.

² In a private communication to the writer, Mr. L. WICKENDEN of the Industrial Chemical Company, Inc., New York, the makers of "Super-Filtchar," said recently.—"In comparing this carbon with 'Norit,' on this particular syrup, we have found that using 2 per cent. of carbon, 'Norit' gives results greatly superior to 'Super-Filtchar.' When 4 per cent. of carbon is used, however, the results are practically identical and when the percentage of carbon is increased to 6 per cent., 'Super-Filtchar' gives a much lighter coloured syrup than 'Norit.' In fact, using this percentage of carbon, a syrup is obtained lighter in colour than can be produced with any percentage of 'Norit.' This is a further proof of the selective action of carbons and seems to indicate that 'Super-Filtchar' has a wider range of selection than 'Norit.'"

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when progressive percentages are used is due to the fact that the increasing percentage of colour absorbed as the amount of carbon used is increased is not the same with all carbons.¹ We would suggest, therefore, in order to obtain the efficiency of a sample of decolorizing carbon, it is necessary (no matter what carbon be used as standard) to make a range of experiments using from 1 or 2 per cent. up to 5 or 6 per cent. with both the standard carbon and that under examination. Moreover, as it is quite possible to obtain results which are somewhat exaggerated by the use of a standard which does not give the greatest decolorizing efficiency if it is required to compare with it carbons of both greater and less efficiency, it is desirable to take for the standard that carbon giving the greatest decolorizing effect with say 3 per cent. and increase the percentages used of the less efficient samples in order to obtain comparable decolorizing effects. That this is the more desirable direction in which to work will be shown later. Suppose in the case of the tremendously efficient carbon mentioned by Mr. THOMAS, which, he says, may be 100 times better than "Norit" and is obtained by digesting a vegetable decolorizing carbon with concentrated sulphuric acid, even if we added 10 times more by weight of this material than is necessary in order to obtain a decolorization equal to 5 per cent. of "Norit" we should not obtain the decolorizing effect we are led to expect with this grade of carbon only.

This brings us to other important points to consider when examining the "comparative values of decolorizing carbons." Mr. THOMAS says, "We cannot here go into certain essential features in the nature of carbons for use in the factory, such as speed of filtration, fineness, etc., and must assume these as being either the same or varying little from one another, but, price and 'factor of efficiency' are two necessary facts in talking of carbons, etc." If it were possible to produce the carbon prepared as mentioned by Mr. THOMAS, which may be 100 times as efficient as "Norit" at about the same price as "Norit," it would surely be useless to a sugar refiner, for how could such an infinitesimally fine carbon be filtered off, or separated from a 50 per cent. sugar syrup? This is naturally a very extreme view to take, but it certainly follows to a less degree with carbons which have a widely different size of grain to the standard, and it will be readily seen if the times of filtration are taken when making the comparative decolorizing experiments. Curve II has been plotted from the actual time we found to be necessary in order to filter off 200 grms. of 50 per cent. sugar syrup during the decolorizing experiments already mentioned. Here again different values will be obtained by different workers unless a standard method of filtration be adopted. Some workers simply allow their hot syrup to filter through filter-paper at atmospheric pressure, whereas we favour a suction pump, etc. Our values were obtained by filtering the boiling 50 per cent. syrup through a double disc of filter-paper using a 2½ in. Buchner funnel and a pump suction equal to a pull of 20 in. of mercury, which was maintained during filtration. Even when working in this way it is very difficult with the longer periods of filtration to keep the syrup hot, so that the values obtained with small percentages of carbon must be exaggerated somewhat. It will be seen from Curve II that, whereas with 5 per cent. of each carbon the times required for filtration are fairly close, when the percentages are reduced the variation is more marked, so much so that we find 2 per cent. Norit takes as long to filter off as 1 per cent. of "Super-Filtchar."

Let us now work on the lines suggested by Mr. THOMAS. We know that 1.6 per cent. of "Super-Filtchar" does the work of 5 per cent. of standard, but, whereas the time required to filter 200 grms. of syrup from the 5 per cent. of standard car-

¹ *Loc. cit.*

bon is under 2 mins., 1.6 per cent. of "Super-Filtchar" will require about 10 mins. for the same weight of syrup. On the other hand, with "X" carbon more than 5 per cent. is required for an equal decolorizing efficiency, and, therefore, the filtration will be more rapid in this case than if 5 per cent. only were used, and may be even more rapid than that given by 5 per cent. of the standard. By using "Norit" as the standard, we are bound to obtain exaggerated rates of filtration for all carbons, which, weight for weight, give greater decolorizing effects than that produced by standard, especially if carbons of less value are also being compared, whereas, if "Super-Filtchar" were used as the standard, greater percentages than 3 per cent. of each of the other carbons would be necessary and the rates of filtration would in every case be increased proportionately. This, we think, again shows the desirability of selecting the carbon of greatest decolorizing efficiency as the standard for comparison, and disproves the assumption of Mr. THOMAS that the rates of filtration are the same, or vary very little from one another. It has been shown¹ that, as a rule, carbons for sugar work require longer periods for filtration as the decolorizing efficiency decreases, and this is usually due to the sample being of smaller bulk than a normal carbon, weight for weight, the efficiency being influenced also by the size of the grain. When examining carbons for their comparative decolorizing values it should be of interest to the carbon user to see how far the efficiency of his samples is influenced in this manner. We have often remarked that old or disintegrated carbons take longer to press out than new carbon. As nearly all commercial varieties of vegetable carbon are extremely friable, it behoves the user to see how much dust he is buying in his original carbon as he is sure to increase the quantity by continued use, especially if the carbon is intended to do hard work, such as decolorizing raws, etc. To illustrate this point we attach some figures obtained from a sample of new "Norit," together with the same sample after using and regenerating first 10 times and finally after 20 successive treatments and regenerations.

SIEVE MESH. NO. PER LIN. IN.		NEW CARBON. PER CENT.		USED 10 TIMES. RESIDUE LEFT ON SIEVE PER CENT.		USED 20 TIMES. PER CENT.	
60	..	7.50	....	4.28	....	4.33	
72	..	12.80	....	7.38	....	3.02	
84	..	7.61	....	5.15	....	4.19	
94	..	6.96	....	7.39	....	6.47	
106	..	6.43	....	6.16	....	6.83	
124	..	4.60	....	6.17	....	8.77	
passed through 124	..	49.20	....	69.17	....	62.66	

At the moment, for most purposes, owing to the high cost of vegetable carbons, regeneration or reburning becomes necessary, thus adding to the dust found. It will be noticed that a gradual breakdown has taken place with the production of a fairly large proportion of dust (passing a finer mesh than 124) and it is quite possible also, could the original and final grades which passed through the 124 mesh sieve be further graded, to find the final carbon after 20 regenerations contain even smaller carbon than the smallest dust present in the new carbon. Although the percentage composition of the sample of carbon as regards size of grain will, to some small extent, influence the bulk of the sample for a given weight when compared to the same weight of another carbon containing larger grain, this alone does not account for the increased efficiency given by the examples of carbon showing the greatest specific volume. This volume must, to a certain extent, be a measure of friability, because the greater the bulk found, the greater must be the porosity of the sample and, therefore, the more easily must it break down.

¹ I S.J., 1921, 25.

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Summarizing the various points which we have now discussed, we consider that the method of working adopted in order to arrive at "the comparative values of decolorizing carbons" should be based on the following recommendations:—

1. That a standard tintometer or colorimeter be first adopted and used by all workers, the Hess-Ives tint-photometer being suggested.

2. That a standard concentration of solution should be used by all workers as suggested by Mr. THOMAS, say, a 50 per cent. solution of raw cane sugar.

3. That the commercial carbon having the greatest decolorizing effect on a 50 per cent. raw sugar solution (with 3 per cent.) be taken as the standard carbon to which all others should be compared. "Super-Filtchar" would at the moment be a suitable carbon for this purpose.

4. That comparative treatments of both the standard carbon and the samples under examination should be made, using from 1 or 2 per cent. up to 5 or 6 per cent., and the decolorizing results obtained, plotted as curves so as to show readily the relative efficiency.

5. That the periods of time required for filtering off a given volume of the 50 per cent. raw sugar solution after treatment by the carbons under examination under standard conditions should be observed for comparison.

6. That the composition of the sample as regards size of grain should be approximately ascertained, the percentages left on a number of definite-sized sieves being stated. The residue left on sieves of 60, 106, 124 mesh and the proportion passing through the latter mesh would be sufficient.

7. That the volume for a common weight should be taken, as this is a measure of porosity, and also of friability.

If some standard method on these lines were adopted, it would lead the present writer to agree with Mr. THOMAS that "chemists will be assisting in reducing this new branch of physical chemistry to some sort of order; and also giving, not only to the sugar manufacturer, but to a number of other industries which use decolorizing carbons, information which will be of real value to them."

The Laboratory,

Messrs. Peek Frean & Co., Ltd.,

Drummond Road,

Bermondsey, London, S.E. 16.

Regarding the capacity of British refineries, Mr. GEOFFREY FAIRRIE, in correcting certain misstatements on this subject,¹ writes that the Clyde houses melt about 5000 tons per week; HENRY TATE & SONS, London, more than 2000; FAIRRIE & Co., Liverpool, over 3000; and MACFIE & SONS and the Sankey Sugar Co. together slightly over 2000 tons weekly. All the British refineries together are capable of melting about 1,000,000 tons per annum.

It was claimed for "Tetraphosphate," a phosphoric fertilizer,² that it had the same manurial value as superphosphate, and provided phosphoric acid at a cheaper rate. It was made by roasting phosphorite with 6 per cent. of a mixture of calcium and magnesium carbonate, sodium sulphate, and sodium carbonate, and hydrating while still hot. Soon after an Italian company for the exploitation of the process had been formed, A. MENDOZZI declared that it was substantially nothing but phosphorite. A commission has now examined the question exhaustively³; and their nett conclusion is that manuring tests showed "Tetraphosphate" and phosphorite always to produce a little higher yield than in the absence of any phosphoric fertilizer, but that both were always inferior to superphosphate. There were only slight differences between "Tetraphosphate" and phosphorite, and these mostly came within the limit of experimental error.

¹ *Louisiana Planter*, 1921, 66, No. 25, 394.

² *I.S.J.*, 1918, 567.

³ See report in the *Chemical Trade Journal*, 1921, 69, No. 1783, 98.

Publications Received.

Notes sur Le Contrôle Chimique des Sucreries. By Henri Sachs. Second Edition. (Imprimerie L. Derolez, 35, Rue Wiertz, Ixelles, Bruxelles, Belgium.) 1921. Price: 15 francs.

At the International Congress of Applied Chemistry, held in Paris in 1900, the Sugar Section unanimously agreed that for the moment "the procedure elaborated by Mr. SACHS for the control of the work of sugar factories is the best, and that its general application is to be recommended for the control of all *sucreries*. . . ." Mr. SACHS, that is the late Mr. FRANÇOIS SACHS, who died in Brussels in March, 1919, had at this time already applied this system of chemical control for a number of years, and since 1892 the sheets tabulating the data for Belgian and Dutch beet sugar factories have been published annually. In this small book, Mr. HENRI SACHS, his son, briefly states the principles upon which the very simple system is based, and at the same time describes the procedure to be adopted for the routine analysis of the various products from juice to final molasses.

It may be noted that as the starting point Mr. SACHS does not take the weight and sucrose content of the roots, as might almost be expected in the case of a material of this nature; but commences as in the cane sugar factory with the raw juice entering into process, the weight and sucrose content of the roots being calculated back after ascertaining the volume and sucrose content of the juice and adding the losses in the pulp and diffusion waste waters. The next product serving for examination is the first massecuite; but, since the direct determination of its volume presents practical difficulties, its weight and composition is calculated from the weight of the first sugar and the volume and composition of the second massecuite. In this way the losses (known and unknown) occurring between diffusion and boiling are ascertained; while the analysis of the first and second massecuites gives figures from which the probable yield in first and second sugars are calculated.¹ This with a few other determinations appears to complete the compilation of the control data considered to be necessary, which data are therefore much less elaborate than those ordinarily obtained in the modern cane factory practising a fairly thorough chemical control.

It remains to add that Mr. Sachs' descriptions of the various analytical processes leave nothing to be desired in respect of lucidity and precision. His small book should therefore serve most admirably as a manual for the young chemist taking part in the simple system of chemical control here described, which has been adopted by a number of Continental beet sugar factories.

Finding and Stopping Waste in Modern Boiler Rooms. Second, revised, and enlarged edition. Publication No. 995. (H. S. B. W.-Cochrane Corporation, Philadelphia, Pa., U.S.A.) 1921. Price: \$1.00.

This is an exposé of the science of the economical utilization of heat in the modern boiler plant, and we recommend it as a particularly clear, comprehensive, and thorough treatise which should be read by managers and chemists desirous of securing the greatest efficiency possible in this department of the factory or refinery. It is divided into five parts, dealing successively with fuels; combustion; heat absorption; boiler efficiency and testing; and boiler plant proportioning and management. The latter two sections will be found to constitute the most informative of the book, the principles previously discussed being here put

¹ Thus the yield in first sugar per 100 of first massecuite is found from the formula:— $\frac{s - Qc}{S - Qc} \times 100$, in which s is the polarization of the first massecuite; c its content in ash; S the polarization of the first sugar; C the content in ash of the first sugar; and Q the saline quotient of the second massecuite. To obtain the same figure, one may also apply the formula: $\frac{s - Pb}{S - Pb} \times 100$, in which b is the Brix of the first massecuite; B that of the first sugar; and P the quotient of purity of the second massecuite. In these formulae, one may of course replace the first massecuite by the second, the second massecuite by the molasses, and the first sugar by the second sugar.

Publications Received.

into practice. Instructions are given, for example, for the performance of boiler trials and the interpretation of the figures obtained. A system of assigning to each workman a well-defined task in the operation of the boiler plant with a bonus if properly performed is advocated, and is stated to have proved successful when well organised. Instruments thus used are not for the purpose of "showing up" the firemen, but of securing better results for him and the management. Presumably this book is intended to serve as a manual for those adopting Cochrane instruments for measuring and recording the boiler feed, condensate, cooling water, etc., though one is hardly aware of this fact until a few pages of advertizing matter at the end of the book are reached.

The Formation of Colloids. By The Svedberg. With 22 illustrations. (J. & A. Churchill, London.) 1921. Price: 7s. 6d. net.

Colloids or disperse systems in general may be formed in two ways, differing in principle: (1) by condensation, and (2) by dispersion. In this small book, the well-known Swedish investigator SVEDBERG develops the application of these two methods of colloid formation. Details are given for the preparation of metallic and non-metallic sols by the first method; while under the second method partial dissociation, grinding, and emulsification are distinguished. Recent work points to the conclusion that under suitable conditions it will generally be possible to produce rather highly disperse systems by purely mechanical subdivision.

A Handbook of Laboratory Glass-Blowing. By Bernard D. Bolas, with numerous diagrams by Naomi Bolas. (George Routledge & Sons, Ltd., London.) Price: 3s. 6d.

Chemists should possess a certain adeptness in glass-blowing, and should at least be able to join a glass tube, make a T-piece, and perform other simple operations of this kind. Glass-blowing is an art which of course cannot be learnt by the perusal of a book, but demands the expenditure of a good deal of time in careful practice. Nevertheless this excellent little book which Mr. BOLAS has written will do much towards saving many of the hours normally spent in acquiring skill in certain operations; and, generally speaking, cannot fail to be of great service in giving expert advice regarding the best methods of manipulation under different circumstances. It is an excellent small guide, well written and clearly illustrated, and we think it should be in the hands of all laboratory workers.

Recherches Physico-Chimiques sur l'Inversion Diastasique du Saccharose. Andrée Chaudun. (Masson & Cie., 120, St. Germain, Paris.) 1921.

This is a thesis presented to the faculty of sciences of the University of Paris by Mademoiselle CHAUDUN for the purpose of her qualification for the degree of doctor of physical science. It forms part of a number of researches on enzyme action undertaken under the direction of the ABBOT COLIN, of the Institut Catholique of Paris.

An Account of a New Moth Borer of Sugar Cane (Family Tineidae), together with Further Notes on the Pyralid Moth Borer on Cane (Polyocha Sp.). Edmund Jarvis. Bulletin No. 11; Division of Entomology. (Bureau of Sugar Experiment Stations; Brisbane; Queensland). 1921.

Contents: Introduction; nature of injury; description of egg; description of larva; habits of the larva; the pupa; description of the moth; the male. Notes on infestation and control.

Osservazioni E Ricerche Sulla Barbabietola da Zucchero. Parta Prima. Ottavio Munerati. (R. Stazione Sperimentale di Bieticoltura, Rovigo, Italy.) 1920.

Mauritius Almanac for 1921. Compiled by A. Walter, F.R.A.S. (The General Printing and Stationery Company, Ltd., Port Louis, Mauritius.) 1921. Price: Rs. 10.

Electrometric Methods and Apparatus for Determining Hydrogen-ion Concentrations. Catalogue No. 75 of 1920. (Leeds & Northrup Co., 4901, Stenton Avenue, Philadelphia, Pa., U.S.A.) Obtainable on application.

Co-operative Cane Syrup Canning: Producing Syrup of Uniform Quality. J. K. Dale. Department Circular 149, U.S. Dept. of Agriculture.

Estudios Anatomicos y Fisiologicos Sobre la Cana de Azucar en Cuba. Prof. Dra. Eva Mameli de Calvino. Boletin No. 46, Estacion Experimental Agronomica, Santiago de las Vegas, Cuba, 1921.

Report of the Lubricants and Lubricating Inquiry Committee. Issued by the Department of Scientific and Industrial Research, Advisory Council. (H.M. Stationery Office, Imperial House, Kingsway, W.C. 2.) Price: 2s.6d.

Its contents include: Introductory; bibliography; research work instituted by the Committee; bulletins; review of existing knowledge of the subject; recommendations for future research; liaison with American Bureau of Standards; conclusion; and appendices.

Über die Organisationsformen und Finanzierungs-Methoden der Deutschen Rohrzuckerfabriken. [Schemes of Organization and Methods of Finance of German Raw Sugar Factories.] Leonardt Henze. ("Gottinger Tagoblatte," Gottingen, Germany.) 1921. (Reprint of an address.)

Properties of Steam. H. L. Callendar, F.R.S. 531 pages and 85 tables. 1921. Price: 40s. net; Steam Tables separately: 3s. 6d. net. (Edward Arnold, London, W.1.)

Laboratories: Their Planning and Fitting. Alan E. Munby. (G. Bell & Sons, Ltd., London.) 1921. Price: 25s. net.

Soil Alkali: Its Origin, Nature and Treatment. F. S. Harris. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London). 1920.

Die Trocknung der Nahrungsmittel und Abfälle. [The Drying of Food-stuffs and Waste Products]. Otto Marr.¹ (R. Oldenbourg, München and Berlin).

Die Fabrikation der Ultramarinfarben. (Manufacture of Ultramarine Colours.) Laurenz Bock. (Wilhelm Knapp, Halle, Salle, Germany).

Traité Pratique des Emplois Chimiques du Bois. [Practical Treatise on the Chemical uses of Wood, Dealing with the Mfg. of Acetic Acid, Methyl Alcohol, and Alcohol Denaturants]. M. Klar; translated from the German by Dr. L. Gautier. (Béranger, Paris).

¹ See also *I.S.J.*, 1921, 103.

Brevities.

The late DANIEL DE PARS left property to the value of £766,976 4s. 8d., with net personality £753,318.

The Mexican export duty on sugar was abolished last April. It amounted to 5d. per kg. on refined and 3½d. on raws.

It is pointed out in a recent paper by JOHN DON¹ that a sand-filter freshly prepared is capable of absorbing fairly large amounts of ammonia and dissolved organic substances from liquids that are passed through it.

At the recent annual meeting of shareholders in Home Grown Sugar, Ltd., it was announced that the Minister of Agriculture, Sir ARTHUR GRIFFITH-BOSCAWEN, M.P., has consented to open the Kelham beet sugar factory next October.

Centrifugal Separators, Ltd. (which firm controls the Geo patents)² have arrived at an agreement with the Sharples Speciality Co. to work the U.S. patents under license on a royalty basis, and provision has been made for a full interchange of technical information between the two undertakings.

Mr. GEORGE HUGHES³ suggests that his process of absorbing molasses in the pith obtained from bagasse should be used for the transport of molasses from the colonial factory to the home distillery. He has found that 12 parts of the dried bagasse pith is capable of absorbing about 88 parts of molasses at a density of 86° Brix; and he urges planters to make a trial shipment.

Mr. A. J. KELLER has been appointed the representative in the Louisiana district of the Celite Products Company for the sale of "Filter-cel." Attention was recently called in our columns to the advantages possessed by this high grade of kieselguhr for the clarification of juices,⁴ either for the manufacture of sugars or of table syrups; and Mr. KELLER, formerly Superintendent of the Central Stewart, Cuba, is particularly well qualified to advise manufacturers on this new development.

In the annual report recently issued by the Amalgamated Sugar Co.,⁵ the following chemical control figures were given, these being the average of the eight plants operating: sugar in the slices, 15·63; sugar sacked, 12·61; final nett extraction, 12·67; sugar lost in the pulp, 0·26; in the pulp water, 0·10; in the lime cake, 0·30; in the filter-cloth washings, 0·02; in the Steffen waste waters, 0·18; in the molasses, 1·67; and unknown, 0·43, a total loss of 2·96 per cent. of the weight of beets.

Advices from Jamaica indicate that the sugar planters there are in need of financial assistance in order to enable them to tide over the present crop. The Government proposes to guarantee a bank loan to the extent of £400,000, the security being a first mortgage on the crops and lands. A committee which was appointed by the Legislature (say a *Times* telegram) to enquire into the matter reported that the sugar industry of the island was in a perilous condition and can only maintain its position as the key industry of the island if Government aid is forthcoming. Some 35,000 persons are concerned in the industry.

In a recent official report Dr. HOTOWETZ, the Czechoslovak Minister for Trade, states that the sugar surplus for the period 1920-21 can be estimated at about 300,000 metric tons. Out of this total, 215,763 tons have already been definitely disposed of, apart from the French right of option. These sales, calculated on the exchange rates for May 1921 yield 2,250 million Czechoslovak crowns. Compensatory transactions with France (45,000 tons) and with Austria (15,000 tons) will bring in from 500 to 600 millions. If the 100,000 tons forming the remainder are sold at current prices, the gross receipts for sugar will amount to four milliard crowns, which, deducting the purchase price and other expenses, will yield the State a net profit of two milliards.

¹ *Engineering*, 1921, 111, No. 2894, 759-760.

² U.K. Patents 4155 of 1907; 21,421 of 1909; 16,188 of 1911. See *I.S.J.*, 1920, 377.

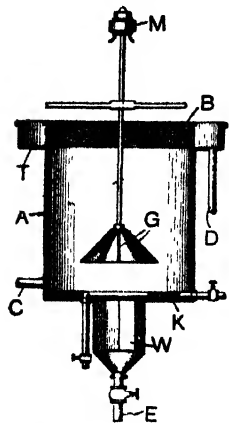
³ *West India Committee Circular*, 1921, 36, No. 584, 74.

⁴ *I.S.J.*, 1920, 332, 643, 690; 1921, 50, 161, 227. ⁵ *Facts about Sugar*, 1921, 12, No. 21, 407.

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MODIFICATION OF THE SULPHITATION PROCESS, THE CALCIUM SULPHITE BEING SEPARATED PREVIOUS TO HEATING. *Irving H. Morse. La. Planter, 1920, 65, Nos. 19 and 20, 301-302 and 315-317.*

It is believed by the writer that if the process of clarification by sulphitation be divided into two parts so that some of the impurities are separated in the cold, and the remainder in the usual way after heating, granulated white and high-grade molasses can be made direct from the cane with no more difficulty than raw sugars. It is explained that if the impurities precipitated on sulphuring and liming in the cold are first removed, the clarification resulting later on heating is rendered more effective. Previous to 1890 it was customary in Louisiana to first separate the precipitate obtained on sulphuring the raw juice, and then lime and heat the clear juice. Both the sugar and molasses produced by this process were of splendid quality; but it was wasteful, as sugar was lost by the inversion occurring during the subsiding of the acid juice, and by the discarding of the unwashed deposit, filter-presses not being in general use at that period. A similar good effect (it is said) can be produced by the application of the subsiding tank invented by the author, of² which three, in tandem, holding all the juice extracted by the mills in 45 minutes' steady grinding may be



employed. They are so connected that the cold juice flows from the first to the second, from the second to the third, and finally from the third to the juice-heater storage tank. Three liming tanks are also used; and after liming the sulphured juice in the first of these, it is pumped into the Morse tank No. 1, its metal cone *C* being set in motion by the motor *M* to effect rapid subsiding. Then the second liming tank is filled, and its contents pumped into Morse tank No. 1, the juice already there being forced into Morse tank No. 2. A third and a fourth liming tank are thus filled and successively pumped into Morse tank No. 1, thus filling first Morse tank No. 3 and lastly the juice-heater storage tank. This cycle of operations is repeated, and the mud drawn off through *E* is filter-pressed and washed. Advantages of this procedure are that when the juice from the heaters is subsided, it is clearer than ordinarily. By means of the sieve at *B*, the *bagacillo* is largely removed; while the amount of scale in the heaters is considerably reduced. Moreover, this new system makes possible the most delicate tempering of the juice before it passes to the heaters, inversion and decomposition of "glucose" both being quite easily avoided.

STANDARDS OF PURITY OF RARE SUGARS FOR USE IN BACTERIOLOGICAL WORK. *Robert S. Black. Paper read before the Sugar Section of the American Chemical Society, 1921.*

In every case the highest possible standards should be prescribed in the case of rare sugars used for the differentiation of bacteria, the growth of which is affected by very small amounts of impurities. Therefore the specification should include data on: the specific rotatory power; the cupric reducing power; the amount, if any, of heavy metals, aluminium, calcium, etc.; the ash; the hydrogen-ion concentration; the moisture content; and the presence of other carbohydrates.

PRODUCTION OF PLANTATION WHITE GRANULATED AND MOLASSES IN LOUISIANA. *V. H. Eckard. La. Planter, 1921, 66, No. 8, 122-124.*

It is said in this article that in Louisiana during recent years the quality of plantation granulated has gradually improved, until to-day it has become possible to make in the factories of that country a grade which is in every respect equal to refined sugar. Such sugars are being marketed as "plantation granulated" with a private brand, the purchaser being

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

² *I.S.J.*, 1919, 565.

thus certain of obtaining a standard article. At the same time, however, a good deal of "off-colour" plantation white is produced, but as the sale of the branded grades increases, that of these inferior qualities should likewise decrease. With the object of assisting manufacturers to produce a uniformly high grade of granulated, and also a good table molasses, the author describes the procedure by which according to his experience the best results are obtained.¹ He asserts that the kind of cane ground is immaterial, whether purple, red or white; but hot sweet water should not be used for maceration, as it produces colour, which passes into the molasses. In sulphuring the juice, the acidity should not be more than 3.5-4.0 c.c. of N/10 KOH per 10 c.c., this being then limed back to a little less than the natural acidity of the juice, namely about 0.8-1.0 c.c. It is considered of no consequence whether the sulphurous acid of the lime be added first, though this point has been much disputed elsewhere,² and another point made is that sulphuring and liming in excess of the limits specified results in a sugar that does not keep its colour for any length of time, and gives a molasses that has an acrid taste. After being sulphured and limed, the juice is heated to 180-200° F. (82-93° C.), and run into open defecators with coils capable of heating to 212° F., which may not be a very up-to-date installation, but nevertheless is one that in the opinion of the author has never been equalled for the manufacture of white sugar, being both simple and certain. He also recommends the practice of removing the blanket at the time of its formation with a sweep, and passing it to the filter-presses at once. The clear juice from these defecators is further cleaned, either in brush pans or filter bags, preferably the former, as less labour is demanded, though live steam is required. Additional lime must not be added either to the scums from the brush pans, or to the settlings from the defecators, previous to the filtration of these sediments, but kieselguhr ("Filter-cel") at the rate of 2-3 lbs. per ton of cane should be well mixed in, the result being such that "it will be a pleasure to have a filter-press station in the house," the mud filtering rapidly and the cloth remaining reasonably clean. After concentrating the juice to 30° B \acute{e} . (54° Brix.), the syrup is allowed to stand in the syrup tanks; and if clarification has been properly carried out very little insoluble matter will deposit after a time. These bottoms are returned to the raw juice tanks. Details of boiling in the pan will be influenced by the capacity of this station, and by the arrangements of cut-over pipes, of mixers, and of molasses tanks; but if uniform sugar is to be expected attention must be given during every strike to the control of the vacuum, the application of heat, the keeping of the massecuite as thin as possible until boiling-in begins, the making of the correct amount of hard grain at one time, and the boiling-back of the molasses. As a rule it will be possible to exhaust the liquors in two boilings, making the first massecuite from syrup and wash separated from the run-offs of the second massecuite, and the second massecuite from syrup and all the wash and run-offs (not separated) from the first massecuite. Liquors must not be allowed to circulate; but beyond this principle, and those generally employed in actually boiling a pan, no rules can be given. Regarding the molasses, previous to selling this by-product, it is generally taken through the pan, in order to get the correct density, and extract the air bubbles it contains. In the curing of the massecuites the use of crystallizers is an open question, though their advantage in the manufacture of raw sugar is of course undoubted. "The working of crystallizers means a definite sacrifice of the molasses, and . . . means in the end also a sacrifice in the quality of the sugar for quantity production . . ." Lastly the sugar is passed through granulators, and packed in bags of suitable size, viz., 100 lb.

"GLUCOSE" DECOMPOSITION IN WHITE SUGAR MANUFACTURE, AND THE USE OF INDICATORS FOR DETERMINING THE REACTION OF JUICES AND SYRUPS.
J. W. L. van Ligten. *Archief*, 1921, 29, No. 1, 18-20.

In the literature of white sugar manufacture, much has been written on substances (either already present or subsequently formed during the process) which by reason of their OH-ion content are dangerous to glucose decomposition. Little, however, has been said about those other substances which prevent or retard this decomposition. Almost

¹ See also *I.S.J.*, 1913, 286. ² See MAXWELL, *I.S.J.*, 1912, 230; also CROSS, *ibid.*, 1913, 436-437.

generally for establishing the acidic or basic properties of juices, syrups, etc., use is made of indicators as litmus, phenolphthalein; whereas in sugar liquors a number of weak organic acids are present, the neutral point of which dissociated compounds cannot be determined by these indicators. If, therefore, a "neutral" reaction to litmus or phenolphthalein is indicated, it does not follow that there will be no "glucose" decomposition. As an example of a substance having an inhibitory effect on glucose decomposition by OH-ions may be mentioned the amino-acids, as glycocoll, aspartic and glutamic acids, which may react either acid or alkaline depending upon the medium. Let us take a solution of an amino-acid, say aspartic acid, or the amino-acid amide, asparagin, all of which show red to litmus, and run in a weak solution of alkali until there is a colour change. This mixture being alkaline should be dangerous at high temperature to glucose decomposition, but it is not, for on boiling it with a solution of glucose no brown colour appears. More alkali may even be added; and it will be just about when the nitrogenous compound and the alkali are present in equivalently equal amounts that decomposition will commence to be apparent. Some laboratory experiments demonstrating these points are described towards the end of this paper.

FILTRATION OF THE ENTIRE JUICE THROUGH THE MARTEL LEAF FILTER AFTER TREATMENT WITH KIESELGUHR. *Anon. La. Planter, 1920, 65, No. 25, 395.*

At Willbert's Myrtle Grove factory, near Plaquemine, La., Mr. Louis MARTEL has been conducting interesting and promising experiments on the filtration of the entire mill juice without previous treatment with lime or sulphur, kieselguhr only for the adsorption of the colloids being used in the manner suggested by Dr. ZERBAN.¹ He used a leaf filter of his own design,² consisting of a cast-iron box, 4 ft. square, containing 25 frames of galvanized iron encased by filter-cloth, each leaf having an independent outlet cock. An effective flushing arrangement for discharging the cake from the leaves is provided, it being unnecessary to open the box while so doing. In the case of a factory crushing 1000 tons of cane per day, six of these filters giving a total filtering area of 500 sq. ft. are required. Juice from the mills is mixed with kieselguhr (such as "Filter-cel"), heated to boiling point, and pumped through the leaf filters at a pressure of about 30 lbs., water being added later to sweeten down the cake previous to discharging it by flushing. One operator can attend to six filters; and it is said that sugar can be made in 10-12 hours by this system, as compared with the 18-24 hours demanded by ordinary defecation apparatus and settling tanks. As the result of a demonstration, 50 of these filters are stated to have been sold; and this method of working, which is capable of producing high-grade plantation whites, is said to be attracting the attention of a number of other manufacturers.

CAPACITY OF SETTLING TANKS. *Anon. South African Sugar Journal, 1921, 5, No. 4, 347.*

Regarding the defecating capacity in a cane sugar factory, it is usual to allow a sufficient volume to hold the juice of about two hours' grinding, this volume being divided among a convenient number of defecators, so that allowing for filling and emptying the juice in each can stand undisturbed for about $1\frac{1}{2}$ hours. It is assumed that 100 parts of total diluted juice are obtained per 100 of cane, and that the juice arrives at the defecators sufficiently heated. To-day the tendency is towards round defecators of about 5000 gallons available capacity, with slightly conical bottom, and coils for heating. In this type while the bottom should be sufficiently conical for the easy running of the scum, it should not form so great a cone as to hold some juice in addition to the scum. Defecators of the square type with the bottom sloping towards one end or towards the centre are also to be found, and if properly constructed are entirely satisfactory. Regarding the heating surface, this is found to vary somewhat. According to an empirical rule, 1 sq. ft. should be allowed for 5 gallons of juice per hour. Some British makers allow 55 sq. ft. per 1000 gallons of juice capacity; while sometimes 40 sq. ft. are to be found, especially in apparatus made during the past few years during which the cost of copper coil has been

¹ I.S.J., 1920, 332, 643, 699.

² I.S.J., 1921, 301, 358.

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so high. These coils must be connected with proper steam traps, if the heating surface is to give the results expected; and, moreover, they must be kept clean so as to ensure good transmission of heat. Juice settling in a series of defecators has, of course, the disadvantages of keeping a large volume of juice in process, and of using considerable space; but, on the other hand, it has flexibility and facility of operation when compared to modern systems of continuous settling. These advantages, it is considered, go a long way towards explaining the reluctance of manufacturers to discard the older system.

ADDITION TO THE LAST MILL JUICE OF THE LIME NECESSARY FOR CLARIFICATION. *Maurice Bird. La. Planter, 1921, 66, No. 12, 184.*

It is recognized that there must occur a comparatively large loss of sugar owing to the fermentation of the juice during milling.¹ Therefore the author had the idea of trying the effect of treating the last mill juice with antiseptic reagents before using it as maceration liquid by returning it to the bagasse emerging from the first unit. Above the third mill juice channel a cylindrical tank containing a suitable stirrer was installed, and from it a thin stream of milk-of-lime was allowed to flow into the last mill juice, a little formaldehyde being run in at the same time. Owing to the use of hot water for maceration, and to the heating caused by the friction of the rollers, the temperature of this last mill juice was about 49°C. (120°F.); and after having been treated it was sent back to macerate at the first mill. In this way these chemicals became later mixed with the second and third mill juices. So beneficial were the results that more and more lime was added at this point, until ultimately the whole of the quantity of the lime necessary for clarification was thus added. "It seems, therefore, reasonable to conclude that this clarification in the megasse (as it were) must result in more or less of the precipitated impurities of the juice being strained off by the megasse and consequently relieving the work at the filter-presses to a greater or less extent. . . ." That the clarification was greatly improved seemed beyond any doubt, while the sugar cured more easily, and the recovery was better, though other causes operating at the time must have aided this effect. It is said that an unanticipated result was that a practically neutral juice could be obtained with facility from the mills, the least departure from neutrality being easily corrected by regulating the valve of the milk-of-lime tank. Other factories are stated to be following this practice.

QUESTION OF THE DETERIORATION OF BAGASSE ON KEEPING; AND THAT OF THE USE OF LAST MILL JUICES FOR MACERATION. *G. Loos and A. Schweizer. Archief, 1921, 29, No. 1, 21-24.*

Last year² the authors drew attention to the rapid diminution of the polarization of bagasse on keeping. On further examining this phenomenon, it was ascertained that if the sample is so chopped that the outer layers of the cane are very finely divided, the polarization falls from about 3 to 0 per cent. in approximately seven hours; whereas, when the rind remains more or less intact, and therefore mostly only the pith passes through the sieve, the deterioration is much less rapid. Presumably this action is due to an enzyme or other agent present in the rind of the cane.

It is not very difficult to believe that when the last mill juices are used for maceration they should deteriorate at least as quickly as the bagasse juice, seeing that they are distributed over such a large surface of the crushed cane. A study of the control figures of the Modjokerto factory, Java, relating to the purity of the first and last mill juices appears to prove this. Thus, the difference in the purity of the first and last mill juices in the case of a plant having a crusher and four mills, and macerating with water alone, was 5.0 with one factory, and 7.7° with another; but was 11.1, 13.0, and 14.8° in the case of three others, using the last mill juices for their maceration, and 8.1° when water was used during the first half and last mill juices during the second half of the campaign. It is desirable, the authors conclude, that other factories should undertake

¹ See *I.S.J.*, 1921, 271.

² *I.S.J.*, 1920, 169.

similar tests, examining also the effect of the addition of a constant small quantity of disinfecting reagents (as formaldehyde¹ and sulphurous acid²) to the last mill juices used for the maceration.

PRODUCTION OF SUGAR AND OF ALCOHOL (FOR MOTOR FUEL) FROM THE JUICE OF THE AGAVE OR AMERICAN ALOE. *Elie Delafond. Communicated by the author from Mexico City, Mexico.*

Although the juice of the agave (a genus of plant of which the chief species is the magney or century plant, wrongly called the aloe) may contain 10-15 per cent. of sucrose, it has hitherto been impossible to use it as a source of sugar, because of the quantity and nature of the impurities present. However, the solution of the problem has been effected (it is claimed) by the application of the author's recently protected electrolytic method of purification.³ But the great opportunity for the electrolytic process in Mexico is for the treatment of the agave juices to free them from the substances that inhibit the growth of the yeast, and thus to render them available for alcohol production. Two factories were erected in 1909 at Yucatan for the utilization by fermentation of the juice expressed by the machines used for the extraction of henequen or sisal hemp, the production of which is an important industry in that part of the world; but it is stated that this venture failed on account of the difficulty of fermenting the juices, though several methods of preliminary clarification were tried. Success, it is believed, can be achieved by the application of the DELAFOND process, and it is estimated that about 19 million hectolitres (418 million imperial gallons) of absolute alcohol could be produced in Mexico by thus treating the juices expressed in the hemp mills. This spirit would be available for use as fuel for tractors, automobiles, etc.

MICRO-ORGANISMS CONCERNED IN THE DETERIORATION OF SUGAR. *W. J. Th. Amons. Archief, 1921, 29, No. 1, 1-18.*

In 1917, when as the result of the shortage of shipping an immense quantity of sugar was stored in Java, the author was given the opportunity to continue his observations regarding the micro-organism concerned in deterioration.⁴ Plate cultures were made, using a medium of the following composition: sodium phosphate, 1250 grms.; potassium chloride, 1250; peptone, 2500; magnesium sulphate, 1000; sucrose, 100, agar-agar, 20; and distilled water, 1000 grms., which medium being poor in nitrogen favoured the propagation of moulds and bacteria capable of growth in syrups and molasses. A further selection was made by cultivation on sugar crystals having a layer of syrup or of highly concentrated sugar liquor. Regarding the bacteria isolated in this manner, they were found to correspond very generally with those described by LEWTON BRAIN and NOEL DEFRIE,⁵ and are therefore not discussed further, though their inverting effect on sugar crystals was determined, and found to be very active. Coming now to the numerous moulds isolated, the following were identified after careful examination, their colour, the dimensions of their conidia and spores, their optimum temperature of propagation, and other characteristics being recorded: *Aspergillus glaucus*; *A. clavatus*; *A. fumigatus*; *A. oryzae*; *A. nidulans*; *A. varians*; *A. minimus*; *A. flarus*; *A. pseudoclavatus*; *A. giganteus* (all of which are green); *A. candidus*; *A. albus* (which two are white); *A. niger*; *A. ficum* (which two are black); *A. sulfureus*; *A. ochraceus*; *A. Rehmii*; *A. Ostrianus*; *A. wentii* (all of which are brown); and also *Penicillium brevicaulis*; *P. crustaceum* (glauceum); *P. olivaceum*; *P. italicum*; *P. luteum*; *P. purpurogenum*; *P. rubrum*. In the course of the investigation it was noticed that often sugars in a state of rapid deterioration showed only a few micro-organisms on the plates: while some rather good

¹ The coagulating property of formaldehyde should be taken into account.

² SO₂ has been used for this purpose in some mills in Cuba.

³ U.S. Patent, 1,371,997; I.S.J., 1921, 418. Mr. DELAFOND has sent us a photograph of the first white sugar loaf produced from agave juice by the application of his electrolytic process.

⁴ I.S.J., 1918, 40.

⁵ Bull. 2, Path., H.S.P.A.

⁶ The literature consulted, in addition to Lafar's "Handbuch der Techn. Mykologie," were Stoll's Dissertation on "Penicilliumarten," and Wehmer's paper on "Die Pilzgattung aspergillus" in Mémoires de la Société de Physique de Genève, 1898-1901, which latter two contributions provide a marked differentiation between the *Aspergillus* and *Penicillium* varieties between many of which hitherto chaos has prevailed.

Review of Current Technical Literature.

sugars contained a large number. At other times, the reverse was observed, which led the author to conclude that there is no relationship between the number of micro-organism and the degree of deterioration.¹ It was not possible to conclude that the moulds predominate over the bacteria, since neither class of micro-organism appeared to be more harmful than the other.

"PENROL" MOTOR SPIRIT [CONSISTING OF ALCOHOL AND DISSOLVED ACETYLENE]. *Prospectus of Penrol (South Africa) Ltd., 397, Smith Street, Durban, British South Africa.*

This company is now offering for subscription at par 85,000 shares of £1 each for initial working expenses, the capital being £235,000. The purpose of the formation of the company is the manufacture and sale of the motor spirit known as "Penrol,"² which is described as a combination of alcohol and acetylene, the invention of Mr. J. PENHALE, of Johannesburg. Using this fuel, a motor is said to start easily from cold, and extensive trials over 10,000 miles of road are said to have given evidence of the new preparation being in every way satisfactory, so that (it is stated) comparing "Penrol" with the only motor fuel with which it is comparable, namely petrol, the advantages are immeasurably with "Penrol." Extracts from favourable reports from Prof. JOHN ORR, O.B.E., M.I.Mech.E., of the Johannesburg School of Mines, Mr. JAMES GRAY, F.I.C., the Motor Corporation of South Africa, Ltd., and other authorities and companies, are reproduced. Mr. NORMAN L. GERHARD states that using a plant turning out 6000 gallons per day, or 2,000,000 per annum, the fuel could be produced from mealies at 1s. 8d. per gallon, the cost of the mealies being 10s. per bag,³ and to this cost 1d. royalty for the inventor would be added. Therefore the two million gallons would cost £175,000, and would be retailed at 3s. per gallon, leaving a profit of £125,000, or 53 per cent. on the subscribed capital. Instead, however, of a two-unit plant making this two million gallons, a smaller installation would at first be erected, the extra cost of production being 2d. per gallon, a return of £54,157 being thus obtained, or 30 per cent. on the initial capital of £185,000 upon which it is proposed to commence operations.

PREPARATION OF RHAMNOSE. C. F. Walton, Jr. *Journal of the American Chemical Society, 1921, 43, 127-131.*

Flavin is hydrolysed by boiling with dilute sulphuric acid, and the liquid filtered, neutralized with barium carbonate, decolorized, and evaporated under diminished pressure to about 40 per cent. of solids. After precipitating the inorganic impurities by the addition of alcohol, and filtering, the liquid is further concentrated to 70-80 per cent. of solids, and allowed to crystallize, the yield of rhamnose being 20-25 per cent. of the flavin taken.

SOME RECENT DEVELOPMENTS IN WATER-DRIVEN CENTRIFUGES. F. J. Broadbent. *Engineering, 1921, 111, No. 2894, 744-745 (Illustrated).*

ACTIVITY OF WATER IN SUCROSE SOLUTION. W. E. Garner and Irvine Masson. *Philosophical Magazine, 1921, 6th series, No. 243, 484-486.*

MOULDING AND CORING CONE-SHAPED CASTINGS FOR VACUUM PANS. Frank H. Stanley. *American Machinist, 1920, 53, No. 8, 441-442; 1921, 54, No. 8, 308-309.*

These are two short articles on foundry work at the factory of Dibert, Bancroft and Ross, of New Orleans. Illustrations are presented showing the method adopted for (1) moulding the large cone-shaped castings for vacuum pans; (2) boring holes in this same large cone-shaped casting; and (3) drilling flanges on large tank members. A form planing operation is also shown, the work being a scraper bar for cleaning mill rolls, the inner face of which is planed out to a concave surface.

J. P. O.

¹ Compare *I.S.J.*, 1920, 523.

² South African Patents No. 257 of 1917, and 1374; U.K. Patent, 120,792.

³ Consideration is being given in South Africa to a scheme for the manufacture of industrial alcohol from cane.

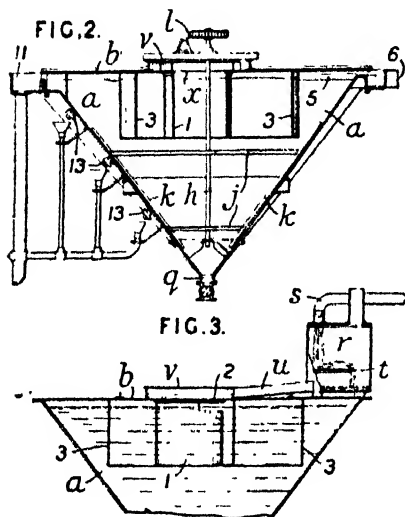
⁴ Published by McGraw-Hill Publishing Co., Ltd., of 6, Bouverie Street, London, E.C. 4.

Review of Recent Patents.¹

UNITED KINGDOM.

AUTOMATIC AND CONTINUOUS SETTLING TANKS. *Cuthbert G. Petree*, of Brisbane, Queensland. 162,206 (15,182). June 4th, 1920.

Tanks for separating scum and sediment from juice are provided with special means for introducing the liquid so as not to cause disturbance, and for separating and discharging the scum. The liquid is delivered by a pipe *s* on to a platform *t* in a receiving-chamber *r*, and passes thence through an inclined channel *u* to a circular distributing-chamber *v* on the cover *b* of the conical settling-tank *a*.



Within the chamber *v* there is an opening *x* in the cover *b*, and the liquid delivered tangentially to the chamber *v* passes round a gallery formed between the wall of the chamber and the edge of the opening and overflows through the opening. Depending from the cover *b* are a cylindrical wall *1* and a volute wall *3*. The greater part of the liquid passes through an opening *2* in the wall *1* and is directed round the tank towards an overflow outlet *11* by the wall *3*. The scum is collected by an inclined plate *5* extending above and below the surface of the liquid and oblique to the direction of circulation. The scum may be removed from the plate to the outlet *6* by blades on a rotary shaft or attached to endless belts or chains or by means of a helical conveyor. Scrapers *k* attached to arms *j* on a vertical

shaft *h*, rotated by worm-gearing *l*, direct the sediment from the wall of the tank towards the outlet *q*. Draw-off taps *13* are provided at different levels for use in emptying the settling-tank.

MOULDING CHOCOLATE, ETC. *Sarotti Chokoladen and Cacao Industrie A.-G.* and *A. Müller*, of Sudende, Berlin. 159,885 (7016). March 3rd, 1921; convention date, March 10th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

MOTOR FUEL CONTAINING ALCOHOL. *Chemical Fuel Co. of America*, of Louisville, Kentucky, U.S.A. (assignees of *E. W. Stevens*). 159,880 (7025). March 3rd, 1921; convention date, March 9th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Alcohol is treated to remove water and render it miscible with hydrocarbon oils such as petroleum oils, benzol and tar oils, to produce motor fuels, by mixing it with fusel oil and a hydrocarbon oil and distilling the mixture. The first fractions, which contain water, are treated to separate alcohol, &c., and the final fractions which are practically free from water are blended with hydrocarbon oils. In the case of low-grade alcohol which contains fusel oils, a further addition of fusel oil is not necessary. A motor fuel prepared by blending the treated alcohol with petroleum oil may be mixed with ether to give quicker ignition and with toluol to prevent loss of the ether.

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Patents.

CENTRIFUGAL SEPARATOR. *G. C. Barnes and J. R. Morgan*, of Coogee, N.S.W., Australia. 159,217 (5862). February 21st, 1921; convention date, February 19th, 1921: *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

In a centrifugal separator with a rotating screw-shaped spiral and a rotating filter basket particularly for the treatment of sugar, or water sewage, the material is fed into the machine through a hollow central axis, and the spiral and basket are rotated differentially from one driving point. End discs carried by the spindle are connected by threaded stay-rods to which are secured the blades of the spiral. The boss of one of the discs is extended to form a driving pulley, and this is connected to the basket through toothed and worm gearing. The end discs of the basket are connected by bars, which have flanges to form seatings for segmental frames which hold the filtering material in position. This material does not extend to the end of the casing in order to provide a free passage for the separated material. At the forward end of the hollow central axis is a hopper with a feed screw at the bottom. The axis is cut away to form a feed opening and has a sliding gate operated by a pinion to vary the point of entry. Pipes within the axis are connected to pipes outside the spindle but within the basket. One of the last mentioned pipes forms a water spray to wash the material, the water then passing through the basket and the outlet; the other of the last-mentioned pipes supplies an air blast to dry the material which then passes through outlet in suitable receptacles.

EXTRACTION OF JUICES, PECTIN, ETC., FROM FRUIT AND VEGETABLE SUBSTANCES. *J. Nicholson*, of Hereford, England. 159,311 (29,245). November 24th, 1919.

In extracting juices, pectin, etc. from fruit or vegetable substances such as gentian root, the fruit, pulped or not, is contained in a strainer suspended in a vessel containing water, and is heated and agitated by injection of steam.

EVAPORATORS. (1) *Barbet et Fils et Cie.*, of Paris. 158,569 (3373). January 27th, 1920; convention date, January 27th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act. (2) *Griscorn Russell Co.*, of New York, and *J. Price*. 158,858 (28,589). August 11th, 1920; convention date, February 9th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act. (3) *Soc. Générale d'Evaporation Procédés Prache & Bouillon*, of Paris. 159,815 (5890). February 21st, 1921; convention date, March 5th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

FILTER PLATE. *C. J. Haines*, of Wimbledon, London. 158,663 (27,526). November 7th, 1919.

A filter plate is described for filtering apparatus of the kind already protected by the inventor,¹ in which unrestricted passage for liquid is allowed from both sides of the filtering medium.

MANUFACTURE OF ALCOHOL. *Badische Anilin & Soda Fabrik*, of Ludwigshafen-on-Rhine, Germany. 158,906 (4634). February 9th, 1921; convention date, February 9th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Ethyl alcohol is prepared by passing acetaldehyde vapour and hydrogen over finely-divided copper, obtained by the reduction of precipitated copper compounds preferably at a low temperature. The copper catalyst is prepared, for example, by precipitating a hot solution of a copper salt by means of caustic alkali, mixing the precipitate with pumice stone, and reducing the cupric hydroxide with hydrogen at 200°C.

U.K. Patents, 6272/00 and 27,007/03.

SACCHARIFYING WOOD FOR THE PRODUCTION OF GALACTOSE AND MUCIC ACID, AND THE MANUFACTURE OF ALCOHOL. *S. F. Acree*, of Syracuse, New York, U.S.A. 160,776; 160,777 (8492; 8493). March 18th, 1921; convention date, March 25th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Wood, particularly that of the Western larch, and other vegetable substances (as cotton seed hulls, corn cobs, or nut shells) are treated in a diffusion battery with a hydrolysing solution in counter current at a temperature of 70-100°C., the galactan thus being converted to galactose. A 2 per cent. solution of sulphuric acid, for example, makes a suitable hydrolyst, using $\frac{1}{2}$ to 2 $\frac{1}{2}$ per cent. of the dry wood or other vegetable substance, the acid being removed from the resulting solution by precipitation with lime. This solution may be evaporated to a syrup and mixed with cotton seed cake to form a cattle fodder, or it may be fermented to alcohol. Alternatively the galactose may be oxidized with nitric acid, or oxides of nitrogen, or electrolytically, and the mucic acid thus obtained may be used (it is said) for the preparation of baking powder, dyes, and mordants, or to replace citric acid for "soft drinks," ices, candies, and jellies. When corn cobs are treated, the chief product is levo-xylose, which may be oxidized if desired to trioxylglutaric acid. As to the spent vegetable material, it is said this may be used for making paper, or may be employed as fuel.

LEACHING LIQUIDS. *Soc. Générale d'Evaporation Procédés Prache & Bouillon*, of Paris. 161,159 (5889). February 21st, 1921; convention date, March 30th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

A horizontal rotary cylinder having a helicoidal worm within it, is divided into compartments by a series of partitions, each having a single orifice at its periphery for passage of the worm. The solids are supplied at one of the cylinders by a worm or other means; and the leaching liquid at the other through a pipe. The liquids flow in a contrary direction to that of the solids throughout the cylinder.

REDUCING AND REFINING COCOA. (1) *E. C. R. Marks* (National Equipment Co., of Springfield, Mass., U.S.A.). 161,210 (27,120). November 4th, 1919. (2) *R. F. Paget*, of Heybridge Basin, near Maldon, Essex. 161,257 (169). January 2nd, 1920.

(1) This patent relates to apparatus particularly applicable for the treatment of cocoa nibs and the productions therefrom of finished and refined chocolate liquor. Means are provided between the reducing and refining devices to mix or churn the coarse liquor from the reducing device and to deliver it to the refining device. (2) In machines for grinding and refining cocoa and of the kind comprising a conical or like grinding element co-operating with a correspondingly conical surface or seat, the substance to be treated is fed into an enclosed chamber from which it is forced between the co-operating surfaces of the treating element and its seat at the smaller ends thereof.

FERMENTATION OF CELLULOSE FOR THE PRODUCTION OF ALCOHOL. *Power Gas Corporation, Ltd., and H. Langwell*, of Stockton-on-Tees. 161,294 (694 and 8115); addition to 134,265. January 8th, 1920.

In the process for fermentation of cellulose described in the parent specification,¹ the degree of aeration may be limited so that mainly acetic acid is formed, or may be increased so that ethyl alcohol is the chief product. The addition of soluble carbohydrates to act as primers may also be dispensed with.

MILL PROVIDING MEANS FOR ADJUSTING THE POSITION OF THE UPPER TO THE LOWER ROLL. *Charles McNeil*, of Govan, Glasgow, N.B. 161,726 (2358). January 26th, 1920. See also U.S. Patent, 1,365,521.²

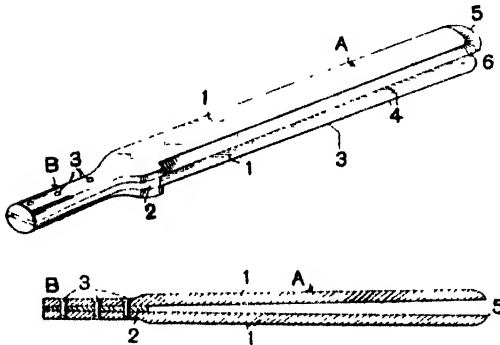
¹ I.S.J., 1920, 180.

² I.S.J., 1921, 231.

UNITED STATES.

CANE STRIPPER. *I. E. Knowlton*, of Medina, Texas, U.S.A. 1,360,765. November 30th, 1920. (Three figures.)

Referring to the drawings, it will be seen that the stripping portion comprises the two blades 1, which are preferably made of some hard wood, such as maple. These blades are integral parts of the handle portion B and are held in spaced relation to each other by a spacing member 2 and are securely attached together by means of suitable rivets 3 which are fixedly attached in the blades and in the spacing member. The spacing member 2 is tapering in thickness, which particular construction serves to throw the cutting blades into relative diverging position, so that they are separated a greater distance at their free end



than at the points of connexion with the handle portion. Each of the cutting blades on the free end and on the outer face, is bevelled, thus leaving an end cutting edge 4. Similarly longitudinal edges of the cutting blades are bevelled on the outer faces, leaving the cutting edges 5. The cutting edges 5 and the cutting edges 4 blend into each other by means of curved cutting edges 6.

The peculiar shape of the improved stripper affords means for making its blades 1 straddle the

stalk at the top, the stalk being inserted between the blades until it is near the handle portion B, when the cutting edges 5 will be in a position to engage the stalk on the side. As the stripper is moved down the stalk, it is moved laterally in reference to the stalk, the diverging arrangement of the blades serving to always keep the cutting edges 5 in engagement with the stalk, so that they may remove all offshoots without gouging into the stalk. At the conclusion of the stripping operation, the end cutting edges 4 are brought into contact with the stalk, since there is the tendency on the part of the person performing the stripping operation to move the stripper from a position at right angles to the stalk to a position where the stripper approaches parallel with relation to the stalk, this angular change of position being more pronounced at the conclusion of the stroke when the end cutting edges 4 are brought into place.

PREPARATION OF A PALATABLE SYRUP FROM SUGAR BEETS. *Sidney F. Sherwood*, of the Department of Agriculture, Washington, D.C., U.S.A. 1,370,372. March 1st, 1921. (For use by U.S. citizens, free of royalty charges.)

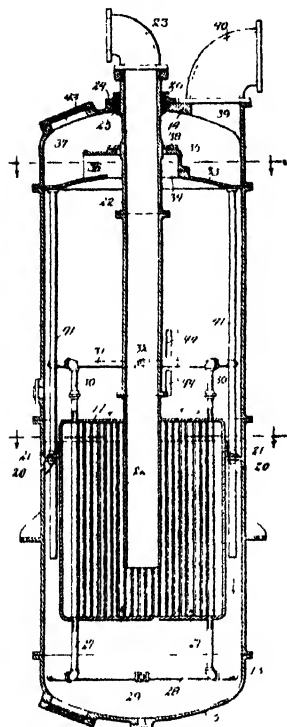
After washing the beets, and removing the tops and upper green portions and preferably also peeling, they are sliced, the slices being allowed to drop into sufficient warm water to cover them and thus prevent darkening. The mass of slices and water is heated to 80° C., and (after covering) allowed to stand for about 1 hour. The extract obtained is strained; and heated to 108–110° C. (about 21 lbs. per sq. in.) in an autoclave for 1 hour, blowing off a substantial quantity of steam at approximately 15 min. intervals. Ordinarily this treatment serves to remove the objectionable "beety" flavour, but when advisable a higher temperature may be used, the time of heating being increased or decreased. On concentrating the extract, a palatable syrup (it is stated) is obtained.

MOTOR FUEL. *Charles le Petit*, of Mombasa, British East Africa (assignor to Power Alcohol, Ltd., of London). 1,377,992. May 10th, 1921.

Claim is made for:—(1) The fuel composition which comprises a combustible liquid containing an aliphatic amine and a formyl ester.

EVAPORATORS, INCLUDING AN ENTRAINMENT SEPARATOR. *Richard D. Kehoe*, of Pelham Manor, New York. 1,363,323. December 28th, 1920. (Three figures.)

Rigidly secured to the upper head 17 of the calandria is a steam inlet type 22 of comparatively large cross sectional area, and terminating approximately two-thirds of the way down from the top wall. Steam is delivered to this pipe from a supply conduit 23 projecting through the wall of the shell. It is important that the joint between the steam inlet pipe 22 and the wall 14 be tightly packed, so that the desired degree of pressure of vacuum may be maintained in the evaporator. As shown, the top wall 14 has a collar 24 rigidly and tightly secured thereto and encircling the steam conduit 22, and having an annular gasket space 25, in which a gasket may be compressed by a gland 26 outside the evaporator and threaded into the outer end of the collar 24.



As an important feature, an entrainment separator is provided in the upper part of the evaporator, illustrated as including a transverse wall 33 which may be supported in any suitable manner by the peripheral wall of the evaporator, as for instance, by being clamped in a groove between the abutting ends of the wall sections 10 and 11. This transverse wall 33 has a central opening 34 receiving the steam conduit 22 and somewhat larger than the latter so as to provide an annular passage for the steam or other vapour rising from the liquid being evaporated. Extending over this passage 34 is a hood 35 provided with a lateral outlet 36 to the compartment or chamber 37 between the partition wall 33 and the top wall 14 of the evaporator. A fairly tight joint is formed between the top wall of this hood and the steam conduit, although it is not necessarily steam-tight, and may be formed by a simple annular collar or plate 38. The vapour may escape from the chamber 37 through an outlet 39 in the top wall 14 which is illustrated as being provided with an elbow 40. The vapours, together with any particles of liquid carried up thereby, will pass at high speed through the restricted passage 34 and impact against the upper wall of the hood 35. The speed of flow will be materially reduced in the outlet 36, which is spaced from the outer wall of the chamber 37. The flow will increase as it passes between the end of the hood and the

wall, and will again decrease in the comparatively large chamber 37. This alternate speed of flow of the vapour and liquid, together with the repeated change of direction of flow and the impact against the walls, will effect a substantially complete separation of the entrained liquid which will flow back into the main body of the liquid through the pipes 41 while the vapour escapes from the outlet 40.

The partition wall 33 is preferably higher at its centre than at the periphery so that any liquid collecting upon the upper surface will drain toward the outer edge. This outer edge portion is illustrated as being provided with a plurality of drain pipes 41 leading downwardly along the walls of the evaporator and terminating adjacent to the lower end of the calandria and below the normal liquid level in the evaporator.

MOLASSES GATE LOCK. *Henry G. Voight*, (assignor to *Sargent & Co.*, of New Haven, Conn., U.S.A.). 1,377,631. May 10th, 1921.

Claim is made for a combination in a molasses gate or spout having a discharge opening of a yolk swivelled thereon, a valve to control said opening, said yolk having a padlock opening positioned upon the side of swivel point opposite said valve, whereby said padlock opening moves downwardly when the valve is moved upwardly to uncover the discharge opening.

Patents.

BEARINGS FOR CENTRIFUGAL MACHINES. *Meredith Leitch* (assignor to the *De Laval Separator Co.*, of New York). (1) 1,073,084. March 20th, 1921.
(2) 1,373,084. March 20th, 1921.

Principal claims are:—(1) A yieldable bearing for centrifugal machines comprising a bearing member presenting a sphere-like surface, a surrounding member presenting an inner cylindrical supporting surface, and a spring confined between said members and so shaped and positioned that the resistance of the spring to lateral movement of the bearing member away from its central position increases in a ratio exceeding the increase in the amplitude of said movement. (2) A yieldable bearing having a sphere-like convex surface, a surrounding support, and a spring confined between the bearing and the support and extending along the axis of the bearing, and having a free end displaceable in the direction of said axis in the lateral movement of the bearing.

METHOD OF HEATING FERMENTED LIQUOR PRELIMINARY TO DISTILLATION. *William G Toplis*, of Philadelphia, Pa., U.S.A. 1,364,160 January 4th, 1921. (Two figures.)

A method of heating fermented wash in such a manner as to realize the most effective utilization of the fuel used in heating is described. The fermented liquid (here called "beer") is pumped up to a tower down which it flows over baffle plates, being at the same time heated by the ascending hot gases from a furnace. It then passes successively through (1) a coil heated by reheated spent wash, and (2) a pipe serving as the grate of the furnace. Thus highly heated, it flows through a distillation tower, where, while passing over baffle plates, it loses most of its alcohol, the vapour of which goes to the rectifying apparatus. However, the wash still contains some alcohol (normally unrecovered), and therefore is allowed to flow over baffle plates in a tower heated directly by the gases from the furnace already mentioned, the alcohol thus volatilized passing up to the tower which the fermented liquor first enters.

WATER-TUBE BOILER. *Hirosuke Horiuchi*, of Tomongai, Taihokucho, Taiwan, Japan. 1,343,874. June 15th, 1920. (One figure.)

Claim is made for the combination in a water-tube boiler, of a horizontal steam drum, front and rear water-boxes substantially vertically arranged and having their upper ends communicating with the interior of said steam drum, upper and lower sets of water-tubes connecting the water-boxes and placing the same in communication, the upper set of tubes being inclined to the horizontal at an angle of greater than 2° in an upward direction toward the rear water-box, and the lower set of water-tubes being inclined to the horizontal at an angle of greater than 7° in a downward direction toward the rear water-box so as to form a V-shaped combustion chamber between said sets of tubes, and a feed water-heater connected to the rear water-box and extending into said V-shaped combustion chamber.

BEST TOPPERS. (1) *James L. East*, of Denver, Colo., U.S.A. 1,373,872. April 5th, 1921. (2) *Harrison D. Prose*, of Macksville, Kans., U.S.A. 1,376,461. May 3rd, 1921.

BEST GATHERER. *Michael Czyzowicz and Jan Szumilas*, of Chicago, Ill., U.S.A. 1,377,468. May 10th, 1921.

BEST HARVESTER. *Albert Bozek*, of Gebo, Wyo., U.S.A. 1,377,593. May 10th, 1921.

CANE MILL. *John L. Stanaland*, of Moultrie, Ga., U.S.A. 1,373,680. April 5th, 1921.

A mill of a type suitable for driving by hand or animal by means of a sweep pole is described.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR. IMPORTS.

	ONE MONTH ENDING JULY 31ST.		SEVEN MONTHS ENDING JULY 31ST.	
	1920. Tons.	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS.				
Germany	180	....	5,831	....
Netherlands .....	....	....	....	596
Belgium .....	....	....	....	....
France .....	....	....	....	....
Czecho-Slovakia .....	....	....	....	....
Java	5,263	....	13,350	21,854
Philippine Islands .....	....	....	....	....
Cuba	36,789	13,447	495,077	124,812
Dutch Guiana	28	200	58	921
Hayti and San Domingo ..	....	40	....	40
Mexico .....	....	....	....	....
Peru	2,629	1,558	25,583	56,066
Brazil	113	3,880	5,887	41,020
Mauritius	6,379	27,702	96,808	181,534
British India	1,305	836	13,516	1,451
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	27,666	7,102	113,239	73,942
Other Countries	9,464	471	24,214	39,774
Total Raw Sugars.....	89,814	55,237	793,562	542,010
REFINED SUGARS.				
Germany .....	....	....	126	1
Netherlands	1	13,538	1,060	64,861
Belgium	258	6	1,898	16,097
France	17	....	27	2,607
Austria-Hungary .....	....	....	102	138
Java .....	....	....	5,010	104
United States of America ..	6,984	40,042	90,203	102,596
Argentine Republic .....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	74	26,733	8,001	97,846
Total Refined Sugars .	7,833	79,319	108,428	284,241
Molasses	2,497	4,447	48,876	43,337
Total Imports.....	99,644	139,003	948,866	869,588

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .....	....	....	....	1
Netherlands .....	....	86	2	1,488
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	109	209	250	921
Canada .....	....	....	....	....
Other Countries	6	191	14	1,729
	114	486	266	4,138
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	100	63	867	222
Unrefined	2,076	487	5,655	1,791
Various Mixed in Bond....	....	....	....	....
Molasses	667	1	2,525	346
Total Exports.....	2,957	1,037	9,313	6,497

Weights calculated to the nearest ton.

United States.

(Willitt & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920. Tons.
Total Receipts January 1st to July 28th		1,520,355	2,047,847
Deliveries		1,482,693	2,047,847
Meltings by Refiners		1,441,844	1,761,031
Exports of Refined		156,000	325,000
Importers' Stocks, July 27th		7,469	none
Total Stocks, July 27th		119,070	82,279
		1920.	1919.
Total Consumption for twelve months		4,084,672	4,067 671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

	(Tons of 2,240 lbs.)	1918-19 Tons.	1919-20. Tons.	1920-21. Tons.
Exports		2,122,663	2,590,502	1,510,416
Stocks		1,153,407	605,308	1,416,943
		3,276,070	3,195,810	2,927,359
Local Consumption		56,000	47,700	64,000
Receipts at Ports to June 30th		3,331,070	3,243,510	2,991,359

Havana, June 30th, 1921.

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SEVEN MONTHS ENDING JULY 31st, 1913, 1920, AND 1921.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	520,387	106,428	284,241	600	867	222
Raw	646,836	793,562	542,010	2,452	5,655	1,791
Molasses	88,036	48,876	43,337	196	2,525	346
	1,254,959	948,866	869,588	3,248	9,047	2,359

HOME CONSUMPTION.

	1913. Tons.	1920. Tons.	1921. Tons.
Refined	508,857	126,836	262,001
Refined (in Bond) in the United Kingdom	427,446	457,828	476,958
Raw	70,180	131,850	75,278
Molasses	18,118	20,920	6,784
Molasses, manufactured (in Bond) in United Kingdom ..	21,731	47,715	26,763
Total	1,046,332	785,147	848,384
Less Exports of British Refined	14,917	266	4,139
	1,031,415	784,881	844,246

Sugar Market Report.

Our last report was dated 6th July, 1921.

The revival of demand indicated in that issue developed rapidly, and throughout the month it has been easy to dispose of sugars available for near delivery. Both here and in the U.S. supplies have been freely taken by the trade to fulfil the seasonal demand, and this, combined with the increased confidence inspired by general market conditions, has contributed to a steady improvement in values. Tate's London granulated is now held for 60s., No. 1 Cubes 64s. per cwt. spot, duty paid. Czecho-Slovak refined was sold to a considerable extent, but further arrivals at Hamburg being impeded by the stoppage of navigation on the River Elbe owing to the dry weather, quotations are nominal at 31s. 6d. f.o.b. for superior granulated, 33s. 6d. for ASP and similar cubes. American granulated met a good demand c.i.f. London, Liverpool, etc., and near arrivals are now held for 31s. 6d. per cwt. Business was done in Belgian crystals f.o.b. Antwerp for October/December delivery at prices ranging from 18s. 9d. to 22s., to-day's quotation being 22s. 6d. By comparison the present price of White Javas c.i.f. U.K. ports (nominally 25s. for September/October shipment) is high, and proves unattractive to buyers, but some second-hand resales were reported during the month at 20s.

On tenders of preferential sugar made against terminal cane sugar contracts dated after 1st August, 1921, one-half of the amount of the preferential duty allowed by the Customs is to be added to the contract price, instead of the full amount as heretofore. Latest business in December, "old terms," 19s. in bond.

Reviewing the latest Continental crop reports, and allowing for exaggerated fears as to the effect of the dry weather, we think it may be said that with the exception of France, no serious damage has been done so far, although good rains are becoming necessary in Czecho-Slovakia. In Holland, Belgium, and Germany the crops appear to be, on the whole, progressing satisfactorily.

From a world market point of view, the past month has provided many interesting features. If one considers the generally accepted statement that Cuba is still the key to the world position, it is a curious fact that the much-feared effect of the marketing of the crop of that island by the Cuban Selling Committee has shown no sign of materialising. On the contrary, circumstances have favoured a policy of steady day to day selling, for the American refiners have been constant takers of raw sugar against the big demand from the trade which they have had to meet. Moreover, France has taken some 10,000 tons, and British refiners have disclosed themselves in the past few days as buyers of prompt shipment, and have accepted 70/80,000 tons of Cuban 96°s at 20s. 6d. to 21s. c.i.f. U.K. The selling price c. and f. New York has been advanced from 3 cents to 3½ cents per lb., which price, in present conditions, is maintained without difficulty, and might even be further advanced before the problem of the disposal of what must still be a considerable surplus has to be finally faced. In the meantime, there are many rumours afloat of financial manipulations, curtailment, or delay of the next crop, etc., which, it is said, may be resorted to as a means of tiding over the ultimate difficulty.

Without doubt the firmness in Cuba has had its effect upon events in Java, where an entirely new position has been evolved. The unsold stocks in the hands of the Syndicate of Producers had been reduced by the end of July to 106,000 tons Whites, and 278,000 tons Browns and Muscovados, as against 400,000 tons and 425,000 tons respectively a month earlier. The Syndicate had been able to sell freely and heavily, supplying not only the actual demand for shipment, but considerable quantities which were taken up by shippers and local speculators, who evidently regarded 11 guilders per picul as a price at which there might be little to lose and more to gain. The sugar thus acquired is held tightly, and the speculation now appears to be forcing the pace faster than the actual demand will follow. Hence the market is irregular, with local Java prices above parity and London quotations for India higher than merchants are prepared to pay. Latest cables report business in Java at 15 guilders f.o.b. for Whites, September/October shipment. This is equal to 23s. 9d. per cwt. c. and f. Calcutta, whilst buyers' ideas are not above 22s.

It is estimated that sales of White Javas to India to the end of July total nearly 300 000 tons, and some authorities speak of further 200,000 tons being required. The question of price, however, must not be disregarded as a factor likely to affect further purchases.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
August 4th, 1921.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Cuban Rumours.

The chief concern of the Cuban sugar industry just now is to dispose of its surplus of nearly 1,500,000 tons of sugar before the new crop sugar enters the market, and everything seems to be directed towards creating a favourable atmosphere for its disposal. Hence there has been no lack of rumours the last few weeks as to the feat having been performed, but none of them seems to have been confirmed, and the sugar market is getting incredulous. The biggest *canard* of the lot was to the effect that British and American banking interests had arranged to buy up the whole of the Cuban surplus of sugar at a price said to run as high as \$250,000,000. What they are expected to do with all this bulk of sugar when the market is already in possession of as much as present consumption needs, is hard to say; but it is fairly obvious that they would not want to lock up their money in this sugar for long, while dumping it on the market would only depress prices and deprive the holders of their chance of selling at a profit. The plan of the Cuban Government to buy the sugar by means of Bonds (to which we referred in our last issue) sounds more feasible, but the loan seems no nearer coming off; in fact, the market is getting chary of believing any of the reports from Cuba of what is going to be done.

Our Cuban correspondent points out (on another page) that it is reliably reported in Cuba that the unpaid bills for sugar machinery and plantation rolling stock delivered to Cuba the last two years or so total some \$400,000,000. Most of this is owed to various American engineering firms, and it is not to be wondered at that so many of the latter have recently been in financial difficulties and have in many cases got into the hands of their banks or even have gone into liquidation. Either way, the result has been that these firms have had to cut down expenditure severely, including their outlay in advertising. Our correspondent suggests that they will now have difficulty in getting their bills paid, because the price of machinery is much lower than when the contracts were placed. In the absence of detailed information as to the legal aspects of these contracts, it is not possible to explain why they should not be binding on the parties concerned; but the net result would appear to be that the parties are not paying in present circumstances. If the American banks who loaned money to

the manufacturers are the ultimate losers, it would be understandable if they cast about for some means of financing the Cuban sugar industry on the stipulation that these debts were met from prospective profits. But one fails to see that they would gain their object by now buying up the Cuban surplus. They would only exchange one adverse balance for another, since unless they locked up the sugar for an appreciable period, its presence on the market would have a bearish, not a bullish, effect.

While on the subject of rumours, it may be mentioned that Germany has been credited with being a prospective purchaser of Cubans to the extent of 1,000,000 tons. This report, too, is not confirmed. But it is interesting to note one theory among many advanced (according to Lamborn's Market Report) for the rumour, which is to the effect that Germany wanted the sugar for shipment to Russia where the need is great; payment for the sugar, according to this theory, would be made through the shipment of manufactured articles by Germany to Cuba and of raw materials by Russia to Germany. Were this plan feasible, it would probably result in Germany offering Cuba sugar machinery at a price that neither the United States nor Great Britain could touch. It is to be hoped, therefore, that it will not be developed.

Conditions on the Continent.

As contrasted with Cuba, where things are at a low ebb for the time being, the sugar industry in Europe is from most accounts doing very well all things considered. This is the case with practically all the French raw sugar firms according to a French correspondent, while the refiners, although for two years they have been on their own and have had to incur the risks of the market, have done extremely well too. On account of the summer drought the sugar beet crop in France this year will be considerably below expectations; instead of 360,000 to 370,000 tons it will only amount to some 270,000 to 280,000 tons of raws. In spite of this setback, however, French agricultural opinion is so strongly in favour of the view that beet crops are beneficial to agriculture generally that the French press loses no opportunity of bringing up the question of rebuilding the French sugar industry and restoring it to something like its former dimensions. A century's experience of this industry is not lightly cast aside.

As for Germany, the same correspondent points out that to judge from the balance sheets of German sugar factories, they too have one and all done extremely well since the Armistice. At the same time it has to be observed that the accounts of the dividends declared in that country are no real criterion of the actual earnings, for the reason that the capitalization on which dividends are declared is the pre-war capitalization, that is to say in gold marks, whereas the dividends are now being declared in paper marks and as it needs a good many paper marks indeed to equal the gold standard, it may be said that the high dividends declared in Germany provide in the end but a small ratio of dividend to the original investment. Still it is indicative of a certain degree of prosperity.

Dr. van der Bijl's Bulletins.

In the June issue of the *South African Sugar Journal* there appeared a note commenting upon Dr. VAN DER BIJL's latest bulletin,¹ in the course of which editorial one may read the following:—

"We endeavoured to reproduce the bulletin, but had to desist because we came to the conclusion that it would not be understood by any ordinary reader. It has always seemed

¹ See page 504.

Notes and Comments.

a great pity that Government officials waste their valuable time airing their technical knowledge in abstruse terms when they might write a paper in plain English, calculated to instruct and impress the reader. This bulletin deals with some fungi and bacteria responsible for the deterioration of sugar during storage, which is a most important thing for the industry in this country, where sugar is known to deteriorate very rapidly owing to what are generally understood to be climatic conditions. It is highly probable that bacteria or something of the kind are much more responsible than the humidity in the atmosphere which has hitherto taken all the blame for the lack of keeping qualities in our sugars. We regret that we have been quite unable to extract any really sound conclusions from a perusal of this bulletin, from which we quote the following paragraphs as examples of the bulk of the matter" [After this followed the description of certain micro-fungi by Dr. THOM, of the U.S. Department of Agriculture, which we have reproduced in full on page 504 of this issue on account of its importance.]

These remarks may be taken as an example of the kind of criticism to which scientific investigators on problems connected with agriculture and manufacture are at times subjected; but that they should be made by a publication professing to represent the progressive sugar industry of South Africa will doubtless occasion a good deal of astonishment.

The criticism is certainly unjust, because Dr. VAN DER BIJL's bulletin was written in such a clear manner that the main conclusions could be understood by anyone with a general knowledge of sugar manufacture. Care had obviously been taken not to write solely for the chemist, the bacteriologist, or the mycologist. In fact when reading this bulletin, and also another by the same author which we recently had the opportunity of reproducing,¹ we were impressed by the skilful way in which the experimental data (such as Dr. Thom's description of the micro-fungi to which the *S.A.S.J.* objects) had been combined with expository information for the benefit of the "general reader." On referring to the articles in question, it will be seen that after recording his scientific data (which must necessarily be stated, in spite of what the *S.A.S.J.* may think to the contrary), Dr. VAN DER BIJL interprets his results in language capable of being understood even by those having no intimate acquaintance with the chemistry, bacteriology, and mycology of the subject in hand.

We are sorry to observe that the *S.A.S.J.* is unable "to extract any really sound conclusions" from this Science Bulletin No. 18, but this failure can hardly be laid to the door of the latter. As a matter of fact Dr. VAN DER BIJL's contribution contains a number of "really sound conclusions," which if put into practice by the manufacturer would probably be the means of avoiding a good proportion of the loss which at present results when raw sugar is stored under improper conditions. Thus, in the first place certain of the fungi responsible for the "sweating" of raw sugars in storage were identified, which in itself is an advance in our knowledge of the subject. Their habits and the conditions which favour or retard their growth and their action in inverting sugar were studied. The influence of the amount of moisture present in a sugar on its deterioration was determined, a question that has also been examined by other workers in this field, particularly by BROWNE² and OWEN,³ it being shown by Dr. VAN DER BIJL that even with 0.5 per cent. of moisture under certain conditions the alteration in composition may be considerable in the case of the particular micro-fungi with which the samples had been infected. These alone are important results.

Coming now to the practical matters which will appeal to every sugar manufacturer, some "really sound conclusions" revealed by a careful perusal of Dr.

¹ *I.S.J.*, 1921, 320-324.

² *Ibid.*, 1918, 226, 265, 319, 370.

³ *Ibid.*, 1919, 277, 331.

VAN DER BIJL's bulletin are that in order to obviate deterioration the sugar must be thoroughly dried before bagging it; that infection takes place after the masse-cuite leaves the pan; that, subsequent to this, care must be taken to work as nearly as possible under aseptic conditions; that the cleanliness of the mill and store-house is a matter of primary importance in reducing the risk of infection leading to deterioration; and that disinfection by means of formaldehyde and chloride of lime, particularly in certain parts of the factory, is highly advisable as a means of ensuring the conditions of cleanliness. In fact, it was concluded that *all* the factors influencing the inversion of crystal sugar by micro-organisms can "as far as the storage of sugar is concerned, be brought more or less under human control, and a little antiseptic wash and attention to hygienic conditions will do much to reduce the micro-organisms growing in store-houses or met with in mills"

This bulletin, and also its predecessor No. 12, are, we repeat, valuable contributions, in which both the theory and practice of the question are well combined. We therefore think the *S. A. S. J.* to be rather unfortunate in its remarks, which on the whole give us the impression of a regrettable lack of sympathy with the excellent scientific work which Dr. VAN DER BIJL is doing for the sugar industry of the Union of South Africa.

The Prosperity of Mauritius.

In a recent number of the *Bulletin de la Société des Chimistes de Maurice* (which is partly printed in English) there is an important article by Mr. H. A. TEMPANY, the recently appointed Director of Agriculture, on the requirements of the sugar industry in Mauritius. First of all, he gives us some account of the present-day prosperity of this island: thanks to a succession of favourable seasons and exceptionally satisfactory market conditions, which have culminated in the phenomenal price of sugar realized for the 1920 crop (£90 per ton), the industry finds itself placed in a position which it has never before attained, while the majority of the interests connected therewith are the fortunate possessors of reserves of capital capable of being utilized for the benefit and for the improvement of the process of sugar production.

"Nobody [writes Mr. TEMPANY] with the most superficial acquaintance with the conditions of this colony can doubt that to the future of the sugar industry the prosperity of the colony is indissolubly linked. Sugar is the mainstay of Mauritius, and so it will remain. Signs are not wanting that capitalists connected with the industry are fully alive to the need for improved methods of working, so that the future conditions may become more assured, the efficiency of processes involved in the production of sugar rendered more efficient, and the industry thereby placed in a position fitting it to withstand more effectively those crises which have, from time to time in the past, so severely beset it, and from which it would be futile to expect an entire immunity in the years that lie before us.

"For the most part, improvements which have so far been undertaken have lain in the introduction of new and up-to-date machinery in the factories; at the time of writing there is hardly a factory in Mauritius which has not made or completed arrangements for an installation of new plant on a more or less extended scale ranging from the introduction of new pieces of machinery, to the complete reconstruction of existing factories or even the erection of entirely new factories *ab initio*, designed to replace one or more existing usines.

Notes and Comments.

"On the agricultural side also a distinct tendency is observed towards efforts to improve cultural methods and modes of transport; particular attention has so far been devoted to the improvement and extension of lines and rolling stock on estate tramways; the introduction of motor transport for the handling of canes, sugar and estates' stores, and the introduction and extension of implemental tillage, combined with the possibility of employing agricultural tractors with the object of economizing the now seriously depleted labour supply available for agricultural operations."

Research and Educational Requirements in Mauritius.

The main part, however, of Mr. Tempany's article is concerned with detailing the existing research and educational arrangements of the Mauritius sugar industry, and in making a strong plea for further facilities to establish on a scientific basis in that island what he describes as "probably the most complicated chemico-technological process [of manufacture] carried out in the tropics."

First as to existing arrangements. Prior to 1893 no systematic provision existed in the colony for investigating agricultural problems, but in that year the Station Agronomique was inaugurated at Réduit under the late P. BONAME, and was maintained by the planting community. Down to 1913, in which year its activities were merged into the Department of Agriculture, it carried out an "enormous mass of useful and patient investigation in the domains of agricultural research." Since 1913 the Department of Agriculture has carried on the work of the station amidst its numerous administrative and other functions, and has issued some 34 separate bulletins detailing its work of investigation. The largest and most important piece of work at present in hand consists in the systematic raising and trying out on an extended scale of new varieties of sugar cane, involving the planting and reaping each year of 1500 to 2000 small plots of cane varieties in different parts of the colony, and their juice analysis. Extensive investigations in manuring are also in progress, while an entomologist gives what time he can spare from administrative work to making investigations. Finally, there is a School of Agriculture where students can be trained in the theory and practice of agriculture, the syllabus including agricultural chemistry, botany, entomology, agricultural science, sugar-house control, and the principles and practice of sugar manufacture; the accommodation is, however, at present confined to ten students. These students in the end qualify as registered agricultural chemists after passing the examinations prescribed by a Board of examiners instituted by the Société des Chimistes, the Department of Agriculture, and the teaching staff of the Royal College.

But with all these activities, there is ample room for the extension of technological facilities, and Mr. TEMPANY mentions in particular the question of research and investigation into problems concerned with the *manufacture* of sugar. It is on the manufacturing side that present-day efforts to improve and modernize productive operations are in general most markedly in evidence, but in Mauritius no systematic provision for such investigation exists, and what advances are made are in all cases entirely the result of private enterprise. Mauritius, which next to India is the largest sugar producing unit in the British Empire (and we should say actually the largest one that really counts), carries on no technological investigations analogous to those undertaken by the experiment stations in Java and Hawaii.

On broad general lines, in Mr. Tempany's view, the proper course would seem to lie in the institution of a definite technological sugar research laboratory for the

benefit of the whole Mauritius sugar industry, under the charge of an officer with adequate training and experience in the technology of sugar manufacture. Whether this is operated as a branch of the Department of Agriculture or as a separate unit is a matter for discussion; but the Department as at present situated could not undertake work of this description. The type of work to be carried on should comprise both laboratory investigations and also large scale tests worked in co-operation with factory owners and engineering firms. The equipment provided might well include a miniature plant for the manufacture of sugar such as exists at Audubon Park (and will likewise exist at the new Trinidad sugar school).

Mr. TEMPANY makes other minor suggestions, but the above represents the chief want which in his opinion exists in the sugar industry of Mauritius. Since, as above shown, the industry is now in a state of great prosperity, his plea comes at an opportune moment, and it is to be hoped that the leading men in the industry will give the proposal early consideration and financial support, and that the result will be to raise the technological side of the sugar industry in this colony to a level more nearly comparable with the highly-trained and managed industries existing in Java and Hawaii.

The India Sugar Corporation.

At the first annual meeting of the India Sugar Corporation held in Bombay in August, the chairman (according to the *Times of India*) dwelt on the probable disappointment with which the Report would be received, but the apparent lack of progress was due to certain factors which made it inadvisable to act precipitately. Rather more than 12 months ago when subscriptions to the Corporation were invited from the public, the rupee stood at 2s. 1d., whereas since that time there had been a steady fall until its value now oscillates between 1s. 3d. and 1s. 4d. This fall, which was not and could not have been anticipated, has reacted against the immediate prosecution of the scheme the directors of the Corporation have had in mind. This depreciation has considerably raised the price in rupees of sugar machinery, and as the price of machinery is in any case abnormally high in Europe to-day, they had decided not to place orders immediately, as in their opinion this would result in an undue amount of capital being sunk in the plant. The rupee might appreciate and the price of machinery fall in Europe if they waited for a while.

Referring to what had been already done, the chairman said they had examined numerous proposals for the establishment of sugar factories that had been laid before them. Of these, the most promising are located in the Deccan at Kopergaon on the Dhoud-Manmad Ry., in Baroda, and in Sind on the Phulleli Canal. Their experts had also formed a high opinion of the potentialities of Burma as a sugar-producing field. Of these schemes, that at Kopergaon has been selected as the one to be developed first, but the actual work has not yet been commenced due to delay in Government offices in preparing the details of the lease under which the Corporation will obtain the land. As soon as these details are satisfactorily settled, operations will commence and the planting of sugar cane will be started. Only gur will be manufactured to begin with, but as soon as conditions are more propitious the erection of a factory to make white sugar will be put in hand.

For the present the overhead expenses of the Corporation have been cut down to the lowest possible figure, and it is being conducted with extreme economy and with every possible regard to the conservation of the subscribed capital, which for the moment remains intact, except for the necessary expenses incurred in forming the Corporation.

Dutch Patent Law.

According to the *Engineer* very important changes have recently been made in the patent laws of Holland which should be studied by all patentees or inventors likely to have an interest in that country. The most important change is that which deals with the examination of a specification based on an application or patent previously filed in a country foreign to Holland. If an application has been filed for the same invention in such country, the applicant for a Dutch patent is required, on the request of the examiner, to state the objections which have been made during the examination of his application in the aforesaid foreign country. This is a very far-reaching condition, and one open to objection. Under it, the Dutch Patent Office appears to be able to demand information which might be to the detriment of the foreign inventor. Assume, as is often the case, that an application filed in his country covers more than one invention. It may happen that during the examination proceedings one part is shown to be old and the other, although new, may be to a certain extent, or even possibly not at all, affected by the patents disclosed. It would appear that the whole of the disclosure as found by a British examiner will need to be communicated on request to the Dutch Patent Office, and, having regard to the difference between the attitude of that Office to the subject matter of an invention and the attitude of the British Office, the specifications which were not relevant to the important part of the British application—possibly the sole remaining part—might be considered by the Dutch Patent Office to be sufficient to bar the grant of a Dutch patent. The onus should not be placed on a British inventor of supplying to a foreign Patent Office the results of a search in the United Kingdom, for which he pays by means of the sealing fee on the British patent. The matter is rendered more harmful because the results of searches made by the Patent Offices of, say, Germany and the United States of America also, presumably, would need to be communicated to Holland on request. Among the other amendments to the law there is an important and helpful amendment which enables the original date to be given to an applicant for a divided application should the Dutch Patent Office hold that his specification contains two inventions.

The *Engineer* also draws attention to an article which was in the last Dutch law also, and might in its opinion be introduced into the laws in this country; this provides that the invention by a person in the employ of another, the nature of the employment requiring the application of special knowledge for making inventions of the same kind as that to which the application relates, is the property of the employer, but the inventor must be recompensed, if not by his salary, then by a special remuneration. On the contrary, if the inventor prove that the merit of the invention is due to him alone, to the exclusion of others, the Patent Office may order his name to be mentioned in the patent. The wording of the contrary clause might possibly be strengthened to make it clear that if the invention does not arise from the nature of the special employment, then it is the property of the inventor and not of the employer.

The latest information is that this new Dutch law comes into force this month, and it is believed that the filing fee is in future to be raised from 25 to 75 guilders.

Owing to the depressed state of affairs in the sugar world, the Jamaica Government do not at present intend to proceed with the erection of a State sugar factory in St. Thomas' Parish. This was to have had a 10,000-ton capacity and to cost £300,000. A large amount has already been spent on preliminary work.

Fifty Years Ago.

From the "Sugar Cane," September, 1871.

In this issue appeared an illustrated article on the methods and apparatus employed in the defecation or clarification of juice. Open pans heated by direct fire, and by steam supplied to a double bottom, were described; but details were given of large clarifying tanks containing copper pipes for heating by means of exhaust or high pressure steam, in order to give the juice "a sharp boil just before the close of clarification," after which subsiding was permitted to take place. A discussion followed on the amount of lime it was desirable to use in defecation. "In most of the ordinary processes of making sugar, the manufacturer is tempted to use too much lime, because, although he thus gets dark sugar, yet he gets a liquor easy to manipulate, and a sugar having a good bold grain, while any insufficiency of lime at once produces a difficulty in crystallizing the products, and thus gives him trouble It is therefore advisable to add lime until the juice can just produce a blue tinge on litmus paper, thus proving it to be slightly alkaline."

LOTMAN contributed a paper on the composition of beets at different periods of their growth, this Dutch chemist having been one of the first to engage in this line of research. Among the data tabulated were the weight, the specific gravity of the roots, the moisture, the dry matter, the weight of juice, and the composition of the juice. It is noteworthy that the sucrose in the juice reached a maximum of only 8.9 per cent. only, and elsewhere in this number reference is made to "the enormous proportion of 12 per cent. of sugar in the roots." These analyses were very complete, even to the extent of determining a compound recently discovered, namely betaine, the amount of which was found to vary from 0.23 in the early stages of growth to 0.08 per cent. of the juice at maturity.

An article reproduced from the *Journal des Fabricants de Sucre* mentioned a case of adulteration of beet sugar by means of dextrin, which had been detected by SCHEIBLER. In the case of a sugar originally testing 92.6°, he found that 1 and 3 per cent. of dextrin raised the polarization to 94.2 and 96.3° respectively. The *savant* chemist concluded that sugar so adulterated may be recognized "by the action of alcohol, which causes a gelatinous precipitate or a marked turbidness; by the coloration caused by the addition of iodine by the differences between polarization before and after inversion; and lastly, by the absorbent action exercised on dextrin by animal charcoal."

This number recorded the death of CONSTANT SAY, the great French refiner, who established a sugar-house which "worked up 80,000 tons per annum, and was being prepared for the enormous quantity of 100,000 representing one-third of all the beetroot sugar produced in France," and which was "the first in the world for organization and the perfection and regularity of its manufacture."

Other articles included "The Dutch System in Java"; "The French Sugar Industry, and the Convention"; "Cuba"; "Increase in the Production of Louisiana Sugar"; and "The Chamber of Agriculture, Réunion."

It is of some interest to note the origin of the sugar imported into the United Kingdom in those days. The British West Indies came first with 138,000 tons for the period from January to August 19th, 1871; then Cuba with 121,000; Brazil, 56,000; Continental beet, 38,000; Java and Manilla, 34,000; Porto Rico, 30,000; Mauritius, 27,000; and British East Indies, 6000 tons.

The Report of the Indian Sugar Committee.

I.

This Report, referred to briefly in our last issue, opens with the Government of India's resolution, dated October 2nd, 1919, setting forth the reason for the formation of the Committee and giving details of its membership, together with the terms of reference addressed to it for the guidance of its deliberations. The Committee seems to have worked very hard, but a scrutiny of the list of actual members ultimately got together suggests that much of their labour must have been expended on acquiring a first hand knowledge of the minutiae of the industry to be reported on. Few of its members had any such knowledge at the start, and the somewhat late inclusion of Mr. G. CLARKE, of the Shahjahanpur Sugar Station, was a wise move, as it undoubtedly strengthened the hands of the Committee in this respect, at any rate as regards the actual and complicated conditions in the main, North Indian tract. The Itinerary (given in detail in *Appendix I*) shows that the area covered was large: 26,924 miles were travelled over by train, 7969 by steamer, and 2154 by road, during the nine months of touring, October 26, 1919, to July, 1920. Within this period 82 sittings were held at which evidence was recorded from 222 witnesses, who were divided, curiously enough, into 111 Europeans and a like number of natives of the country (98 Indians, 12 Burmans and one Chinese). Memoranda were received from 30 other witnesses who were not orally examined. Practically all the Experiment Stations growing cane and the factories producing sugar in India were visited, and a number of informal meetings were held with cane growers and sugar or *gur* makers. Opportunity was taken also of making a visit to Java where the Committee examined the sugar industry in detail for a month, and where they appear to have received every facility from the Government and factory authorities. It is very evident in the body of the Report how important this visit was, as it has materially influenced their decisions in many respects. A vast mass of evidence has thus been got together which, it is to be hoped, will be kept readily available for future students of the industry. This evidence is methodically sifted and the conclusions of the Committee based on it are presented in a very readable form, although there are everywhere signs of rigid compression in the 350 pages of the main Report. Such accumulations of details are by no means exceptional in the case of Committees and Commissions appointed during recent years in India, but it is obvious that the value accorded to the findings of the Committee by the industry and the public at large must depend to a large extent on its personnel, and, considering its constitution, it is a matter for congratulation that the Sugar Committee frankly disclaims omniscience and not infrequently demurs from making concrete recommendations where it feels itself unable to do so with confidence. Much is thus left for further elucidation by the large body of experts which the Committee proposes that the Government of India should call into being, for what is practically a continuation and extension of its work. The conclusions of the Committee appear to be eminently sane and to the point, and it is satisfactory that, with one exception, the Report issued is practically unanimous. The exception is comprised in a note of dissent by Mr. B. J. PADSHAW, who was added to the Committee in place of Mr. LALUBHAI SAMADAS, C.I.E., who was unable to join it. Mr. PADSHAW has thought it necessary to assume the attitude of critic on the Committee's findings in various directions, especially as to their firmly expressed determination that a factory system should not be forced by the compulsory acquisition of land on an unwilling peasantry, as they have throughout considered the interests of the agriculturists as

paramount in the industry. This is expressed by them as follows: "We cannot contemplate with equanimity the establishment of factories in the midst of an aggrieved and sullen peasantry, which we feel convinced would be the inevitable outcome, if land were acquired by Government on any large scale to promote the development of the sugar industry." Mr. Padshaw's note of dissent takes the form of a very long and somewhat diffuse dissertation on the industry in general with strong attacks against the well known trend of Government policy in various directions. And, such being the case, it is a question whether it would not have been more dignified on his part to have retired from the Committee when he found himself so much at variance with their views, and then on the appearance of the Report have criticized it in the usual manner.

THE POSITION IN INDIA.

An introductory chapter reviews the present position of the Indian Sugar Industry as compared with that in the other great cane growing countries of the world—Cuba, Hawaii, Porto Rico—and draws special attention to Java, to which the second chapter is wholly devoted, and from which the great bulk of imported sugar is obtained. The Committee point out that, omitting the indeterminable amount of sugar cane eaten as a fruit all over India, the amount of cane made into *gur* is at present 99 per cent., and it defines *gur* as follows:—"cane juice in its natural state concentrated to solidifying point without having undergone any material process of purification other than the addition of a small amount of alkali or other clarifying ingredient and the removal of scum. When cleanly made it is a perfectly wholesome food and there can be no objection to its consumption on hygienic principles." It estimates, however, that as much as 1,068,960 tons of sucrose as such is lost to India in the process. Naturally the avoidance of this loss is one of the main questions with which the Committee has concerned itself. As regards the making of white sugar, at present only made to the extent of 1 per cent. of the cane supply, the Committee, as is perhaps right, strikes a note of guarded optimism and "allows itself to look forward to the time when India will again become an exporting country, but meanwhile its contribution to the world's sugar supply can be made indirectly by such an increase as will reduce to vanishing point the country's dependence on foreign sources to supplement her own crop." The installing of up-to-date factories producing white sugar is thus a minor factor in improvement, and the Committee reiterates that its main object is to improve the industry from the cultivator's point of view. It has no mandate for the encouragement of the establishment of large factories, unless they can be shown to be of advantage to the cultivators as a class. But a little study of the Report will show that the attainment of this first stage of progress towards a white sugar industry, that of making India independent of imported sugar, will be a long and laborious process, and any belief that India will be able to increase its supplies of white sugar in the immediate future must finally be given up.

It is emphasized that one of the most important factors in the situation is the extraordinarily low production per acre in India. Thus, in countries producing over 500,000 tons, India obtained, in the five years ending 1918-19, an average of 1.07 ton of sugar per acre of cane, Cuba 1.96, Java 4.12 and Hawaii 4.61. In India and Cuba (80 per cent.) the cane is grown by the peasantry, carelessly and with inefficient agricultural methods, while in Java and Hawaii cane growing is under the full control of the factories. The difference is obvious and striking; and in comparing the Indian and Cuban output we must take into account that the produce of the former is an impure mixture of sugar + molasses, and that, while

The Report of the Indian Sugar Committee.

from factory sugar obtained in Cuba 90 per cent. may be converted into refined, only 50 per cent. can be obtained from *gur*. This accentuates still further the inferiority of the Indian output of a plantation product ; but also suggests that, as India's acreage is about equal to that of the rest of the world, any improvement however slight will be of material importance. Excluding India, the world's sugar production was, in 1913-14, 15½ millions of tons, in 1917-18 13½, in 1918-19 13½, and in 1919-20 no more than 12. These figures show how little the cane industry has been able to take advantage of the eclipse of the beet industry whose quota decreased from 44·6 per cent. of the whole to 21·1 per cent., during the same period. The increase in cane sugar has been only 1½ million tons in the last six years whereas, in the six preceding years, it reached 3 million tons, forcibly suggesting that the more important cane growing countries are fast approaching the limits of their economic production of sugar. During the four pre-war years, India imported no less than 723,915 tons of sugar a year at a cost of Rs. crores¹ 12·71, while in the four war years the figures were 531,713 tons a year at a cost of Rs. crores 13·48. By far the greater part of this foreign sugar was obtained from Java, the Mauritius supply showing a decline from 137,641 to 53,279, and that of Austria from 43,594 to nil.

THE PROBLEM.

The broad aspects of the problem are thus presented in the Report. Of the 2,718,000 acres under cane in India, 2,034,000 (or 75 per cent.) are to be found in the great North Indian tract (United Provinces 50 per cent., Punjab 15 per cent., and Bihar 10 per cent.), an area considerably greater than that in Cuba and five times as large as that under cane in Java. In this same tract are also to be found the main centres of the factory and refining industries : and here therefore the Committee is convinced that the most important contribution must be sought to the solution of the problem of making India self-supporting. The local conditions of the tract are then reviewed. From June to September a high temperature and great humidity are experienced, conditions ideal for the growth of the sugar cane, but these are restricted by the great heat with low humidity in the preceding months and the severe cold of the season following. The extreme fragmentation of the holdings is a serious handicap, but labour is cheap, there is excellent soil and irrigation resources are vast, added to which a steady demand for sugar exists at the doors of the factory. The present impossibility of obtaining large contiguous blocks of land and the short growing season of four months are the main inherent difficulties to be contended with ; and, while the first is a matter which, if capable of solution, will require much patient work during many years, the second is of course insuperable.

THE SOLUTION.

We propose now to anticipate by skipping some hundreds of pages, and briefly summarize the more important recommendations of the Committee as to the machinery it would call into being for the improvement of the Indian sugar industry. These are first and foremost, the formation of a Sugar Research Institute with large farm and a network of sub-stations in all the more important sugar tracts throughout India, for a thorough study of agricultural methods, irrigation and manurial needs, varieties grown, and the existing methods of manufacture, with the hope of the discovery of any method of improvement in these directions. The cost of this Research Institute is put down as, at the lowest,

¹ The crore of rupees equals one million pounds sterling at the official rate of 2s. the rupee, and two-thirds of a million pounds at 1s. 4d.

Rs. lakhs 35½ (at 1s. 4d. the rupee £23,310 and at 2s. £35,500) as a capital charge, with a recurring expenditure of Rs. lakhs 12 per annum (at 1s. 4d. the rupee £7992 and at 2s. £12,000), assuming that the sub-stations are self-supporting.

As regards the making of white sugar, the Committee regards it as essential, in the second place, that a pioneer factory should be started under Government auspices in the heart of the great sugar tract of North India. This is because of the special difficulties in this part of India and because it feels convinced that the picking out of local areas where thick tropical canes can be grown is less likely to effect a permanent improvement in the industry as a whole than to attack the main sugar tract with all its disadvantages. The initial cost of this factory is put down as Rs. lakhs 59 (at 1s. 4d. the rupee £49,294 and at 2s. £59,000). The Committee estimates that such a factory would, with sugar at Rs. 20 per maund of 82 lbs., yield a dividend of 26·83 per cent. and with sugar at the conservative rate of Rs. 12 per maund a dividend of 9·42 per cent. Special efforts would be made to enlist Indian capital for the outlay and especially to induce the taking up of shares by the cane growers; but, if necessary, the Government should find the capital required. For the training of subordinates in factory work a Sugar School would be attached to the Research Institute and its cost is included in the figure given above. These are bold and useful proposals, and it is to be hoped that the Indian Government will rise to the occasion and accord its consent in both directions. The conditions in India, as will be seen from the details in the body of the Report, differ very widely from those in any other place where sugar cane is grown, and it is obvious that, unless such recommendations as the Committee makes are carried out on a generous scale, not only will no great forward movement be made in the present generation, but there is the distinct possibility that the industry, acknowledged to be one of the most paying to the cultivators in the country, will steadily diminish in importance, with a continuous increase year by year in the import of foreign sugar.

Meanwhile there is to be no cessation of the good work being carried on in various directions. The Committee is indeed urgent on the need for the immediate expansion of all such work, and it pays a well-deserved tribute to what has been done in recent years in various directions. The Sugar Bureau which has collected great masses of information, and is beginning to feel its feet, is to be continued on the present lines until its absorption in the Research Institute. The work in Bombay on the cultivation of the cane and in the United Provinces on varieties, improved cultivation methods and manufacture are also to be continued, and in both cases the Committee urges immediate expansion under whole time officers. Similarly the Cane-breeding Station at Coimbatore is to be made permanent and its scope is to be extended to the northern tracts and elsewhere. But the detailed considerations of these and other points in the Committee's programme will have to be deferred to another issue of the Journal.

C. A. B.

The amalgamation of Messrs. HENRY TATE & SONS, LTD., and Messrs. ABRAHAM LYLE & SONS, LTD., has now been completed, and the firm are henceforward to be known as TATE & LYLE, LTD.

A. DANIEL¹ is advocating the adoption of levulose manufacture by beet factories, the chicory root being cultivated in place of the beetroot, and the extraction and purification carried out in the factory in much the same way as ordinarily.² Chicory molasses is said to find a good price for the preparation of coffee substitutes, caramel, etc. A factory in Saxony has taken up the manufacture of levulose on these lines.

¹ *Chemiker Zeitung*, 1920, 4.

² *I.S.J.*, 1921, 270.

The Sugar Industry in Java.

As seen by the Indian Sugar Committee.

It is a curious fact that, although masses of detail are published every year about the Java sugar industry, there are few countries about which more contradictory statements are served up by journals dealing with sugar matters. And these statements refer to the most varying factors, such as the relative fertility of the soil, the relations between the planters, the Government and the land-owners, and even the production of sugar in any one year. It may be that this confusion is partly due to the presentation of the information in the Dutch language, which has its own peculiar difficulties to the English or American reader; but, whatever the cause may be, any first-hand description of the industry of an authoritative nature is likely to be welcome. We have therefore thought it worth while to place before our readers a summary of some of the points in the second chapter of the Report of the Indian Sugar Committee, which contains a careful account of their observations during a month's stay in the island. As the Dutch Government and the planting community appear to have given them every facility for forming just views as to the state of affairs in the sugar industry, we may with some show of reason regard this account as more or less of an authoritative nature.

It may be well at the outset to explain that the sugar factory and plantation in Java are under one head, and that the mill and the canefields work in complete accord. Further, whatever may have been the case in the past, the sugar industry is entirely self-contained as regards all investigations for the improvement of cultivation and manufacture. The entire cost of all the complicated machinery for carrying out these investigations is borne by the industry, by means of voluntary cesses on acreage of cane, amounting at the time when the report was written to about 6s. per acre planted; and the expenditure for research alone during 1919-20 reached the sum of 1,200,000 guilders or £105,000. No help was obtained from Government, whose experimental stations are mainly, if not entirely, concerned with crops other than sugar cane.

It is generally recognised that the success of the Java sugar industry during recent years has been mainly due to the intricate organization for the solution of the many difficulties which occur in all cane-growing countries, and of which Java has had its full share. This organization will accordingly be dealt with in this note in some detail, especially as it is entirely built up by an industry as contrasted with a Government, with all the attendant directness of view and practical nature. And it is none the less surprising that nowhere in the sugar world is a higher value placed on the work of pure as well as applied science. This we have, during a long experience, come to regard as a characteristic feature of the Dutch, namely, a great appreciation of the value of modern scientific work, coupled with a peculiar capacity for the practical application of the results obtained.

For the administration of the affairs of the industry as a whole, at any rate those factories who have agreed to pay the cesses, two main bodies have been called into existence, a General Syndicate of Sugar Manufacturers and a Research Station Association. The *General Syndicate*, with headquarters at Soerabaya, is maintained by a cess of 1.25 guilders per bouw (the guilder = 1s. 8d., and the bouw = $1\frac{1}{2}$ acre), up to a limit of 1750 bouws under one control. Its sphere of action is of an economic and political nature, and it forms a channel through which its members can make their influence felt by Government, as to the relations between factories and land-owners, the levying of export duties, and matters of similar nature. The functions of the Syndicate are divided between three

separate bodies, the General Assembly of Members, a Council, and a Board. The Assembly usually meets twice a year (although special meetings may be called), and its main work is the fixing of the annual contribution by the members, passing the accounts, and sanctioning the budget. The Council is a purely advisory body, but from the nature of its constitution (mentioned below) it has great influence with the Board, which is the main executive body. The Board usually meets once a month, under a president who has large powers for the transaction of ordinary business between the meetings, and is assisted by a permanent paid staff. Half of the members of the Board are nominated by the Council and the other half elected by the Assembly, which also appoints the president. For keeping in touch with all the factories which are members of the Syndicate, the island is divided into 16 sections, which more or less correspond with the Government administrative divisions, and each of these sections has a local Board, whose chairman is always the manager of a factory within its limits. It is the 16 chairmen of these local Boards who form the Council of the Syndicate, as well as the Council of the Research Association to be referred to later. Thus, all parts of the industry are fully represented in the management of affairs.

The *Research Association*, which appears to have a similar constitution to the General Syndicate, deals with agricultural and manufacturing matters, and has, as is natural, a more complicated network of sub-divisions. Under the Executive Board there are three independent departments: Agricultural, with headquarters at Pasoeroean, and Chemical and Engineering at Semarang; it will be necessary briefly to consider the work of each of these. The funds of the Association are derived from a cess of $4\frac{1}{2}$ guilders per bouw under cane, with an additional $\frac{1}{2}$ guilder where a "group adviser" is employed (as detailed below), making a total of 5 guilders per bouw, up to the limit of 1750 bouws under one factory as before.

The Agricultural Department.—To the buildings at Pasoeroean a farm of 25 bouws is attached, for the use of workers in the various sections, with the novel condition that the land is rented season by season, just as is the case with factory lands. There is also a sub-station at Cheribon, in West Java. There are a director, assistant director, and secretary, and scientific heads of the following sections:—Physiology, agro-geology (including the chemical analysis of soils), cane-breeding, bacteriology, statistics, and field experiments. Formerly, there were also entomological and mycological officers, but these have been abolished as no longer needed, because of the successful control of pests and diseases by efficient cultivation. Broadly speaking, the work of the department is concentrated on seeing that the right kind of cane is grown on the right soil, the evolution of hardy and heavy yielding varieties of cane, and the elimination of disease by proper control. The most important investigation at present being carried out is on varieties, but much is also being done on the testing of seed from different sources (e.g., hill and plains nurseries), reduction of sets per acre, depth of planting, width of rows, possibility of replacing sulphate of ammonia by some other manure, the amount of nitrogen needed per bouw for every field, the necessity or otherwise of phosphatic manures, the best time of applying manures, the use of waste products, etc. In order to keep the work at Pasoeroean available for the plantations, a special set of touring officers is attached to the section of field experiments. There are at present about 11 of these, and each has from 10 to 20 factories in his circle. They communicate the Pasoeroean results to the managers, and are consulted by them as to varieties, diseases, etc., and are therefore termed "group advisers"; they collect information for the heads of sections, make soil

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surveys and a soil map of all plantations employing them, and conduct on the average one experiment each year on every estate which is willing to bear the cost. This is usually readily conceded, as the experiments are almost invariably financially profitable.

The *Chemical and Engineering Departments* are stationed at Semarang, and are under a joint head who is a vice-president of the Research Association. Each has its own director and secretary. The Chemical Department has two sections, one of which deals with purely scientific matter, analyses, etc., while the other deals with technical research and chemical control in factories. The Engineering Department has also two sections, the first having four sub-sections, namely, consulting, technical research, mill control, and office, while the second is purely electrical. The heads of these sections and sub-sections are recruited from the Technical School at Delft. Among the subjects at present being worked out are briquetting of bagasse, behaviour of bagasse under pressure, the best methods of taking samples for mill work, the best methods of driving mills by electricity, and so on. The two departments publish fortnightly figures of the working of the factories on the chemical and engineering sides, and prepare a complete synopsis of the season's results. As the officers constantly visit the factories, there are no group advisers.

Relation between the factories and the landowners.—The arrangements are a survival of the culture system of Governor VAN DER BOSCH a century ago, all compulsion having long ceased; and the success of the industry is largely dependent on the agricultural control of the land by the factories during the term of their lease. No non-native can acquire land in Java from a native, and the longest lease is therefore fixed at 21½ years, although it is usually much shorter, namely for the time required to grow one crop of canes, roughly a year and a half. Rent is fixed at a figure supposed to equal the profit which could be obtained from one crop of rice and two dry crops, which could be raised in the time, and is subject to revision every five years. The minimum rent as fixed by Government is now about 60 guilders per bouw per annum, or 90 guilders for the season: besides this, from 2 to 7½ guilders are paid for returning the land to its normal condition for a rice crop. Competition between factories for the land is impossible, for they have to be licenced by Government and are not allowed to interfere with one another or with the food growing needs of the people. For safeguarding the latter not more than one-third of the land in any village may be leased. New licences are now very rare and the number of factories in Java has for some time been practically stationary.

Cultivation.—The most interesting of the methods employed by Java is that of procuring sets for planting. These are obtained from three sources, hill nurseries (1000-3000 ft.), plains nurseries and tops of the crop cut on the plantations; and owing to the great cost of the first, the tendency is to increase the second source, the nurseries either being off the estate but at a lower level or even on the estate itself. In both kinds of nurseries no cane is harvested, but the plants are cut up after six months' growth, producing two to three sets each stalk. In the plains nurseries another method is also employed, only the top being cut off and the remainder being left to grow for a further 10-45 days, after which the whole is cut up: each set then has one or two young shoots whose leaves are trimmed to prevent evaporation: these shooting sets are termed "*rajoengans*" and are used for middle and later sowings. They are only produced on factory lands, as they cannot be transported far. Some sets are always obtained each year from the hill nurseries, the average for most of Java in 1918 being 35 per cent. hills,

31 per cent. plains, 34 per cent. tops; while in Djokjakarta where the climate is favourable the figures were 4 per cent., 66 per cent., and 30 per cent. respectively. The quantity of hill sets required for one bouw in 1919 was $3\frac{1}{2}$ - $4\frac{1}{2}$ tons, costing 93 guilders per bouw (68s. per acre) against 40 guilders per acre (30s. 8d. per acre) for plains sets. The method of nurseries permits of very rapid multiplication of new varieties, as this is at the rate of eight times in six months, or 4096 times in two years. With the preliminary period of testing at Pasoeroean, which is severe and lasts two to three years, it takes a minimum of five years for a new variety to be extended over 5000-6000 bouws.

An interesting table is given of the changes which have taken place in the varieties grown in 1912, 1919 and 1920. The most marked feature is the diminution of 100 P.O.J. and 247 B (the correct naming of J 247). The increases have been in E.K. 28, D.L. 52 and, to a less extent, in E.K. 2, none of which is found in the 1912 list.

The laying out of the cane field in Java after rice is comparatively well known, and is left out here for want of space. It may be mentioned that the rate of converting the sodden paddy land into friable sugar cane soil appears to be little less than miraculous, and seems to be due to the fact that the soil in Java sugar estates does not suffer by being *worked wet*, but as soon as it dries it becomes friable and well aired. The preparation commences as the paddy harvest is being reaped and as much as 50 per cent. of the trenches and furrows on a 3000-acre estate is completed by the time that the paddy is completely cut. After the furrows and trenches have been finished, the land is left to air for five or six weeks before planting commences. Cultivation is almost entirely done by hand labour, and this alone will preclude any other country from following the system, even if its soil will bear such drastic treatment. Water for irrigation is almost always sparse and the greatest care is necessary to avoid waste: the sets are never flooded but merely splashed at frequent intervals when recently planted, a proceeding again demonstrating a good labour supply.

Ammonium sulphate is the manure most used, there being usually two doses, at three and seven weeks from planting; the manure is placed in small holes on opposite sides of the young plants and covered over. The economic optimum worked out at Pasoeroean is 400 lbs. per acre (80 lbs. N), but many factories have worked out their own optima, and in some cases have found it to be as much as 550 lbs., in which case the manure is applied in three doses at 3, 7, and 11 weeks from planting. Occasionally phosphates are given but potash is not needed, and these elements appear to be added to the soil in sufficient quantity by the water irrigating the paddy crop. A case is noted of a dry, coarse sandy land, where 1500-2250 lbs. of molasses per acre gave useful results by improving the water-holding capacity of the soil.

Details are given in a table of the cost of production of cane, and this is compared with that on two of the chief experimental stations in India. The cost of cane at the factory in Java, on 177 plantations in 1918 worked out at 4.63 annas (or pence) per standard Indian maund (about 82 lbs.), or one anna less than the Indian examples, which however were obviously not strictly comparable.¹

Supervision.—This is wholly in the hands of Europeans, whether in field or factory, and much of the efficiency in the industry is undoubtedly due to this fact. An important part of the European staff is recruited in Holland, and many of them are graduates of the Agricultural High School at Wageningen or of the

¹ In Chapter II of the Report, the rupee is taken for convenience as the exact equivalent of the guilder, that is at 1s. 8d. On this basis, 4.63 annas equal 5.9 pence. With the rupee at 1s. 4d. as it is at present, the anna exactly equals the penny.

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Technical High School at Delft. Wherever possible young chemists are employed in the factories for three or four years and then offered posts as assistant managers, and the chance of being promoted to factory managers depends on their ability to master the agricultural side. The Research Station officers, not being Government officials, are interchangeable with those of the factories. An important feature is the great importance attached to the possession by all higher officials in a factory, whether chemists or engineers, of a knowledge of all branches of factory and plantation work. The average number of Europeans on an estate (factory and plantation) of 1200 bouws (2100 acres) is 20.

Factory work.—The sugar factories in Java are up-to-date, roomy and efficient. They are 186 in number and, of these, returns are available from 138 to 145, though engineering details are only available from 77 to 100. Crushing lasts from May to October, with slight variations from these dates in certain districts: the average length of season is 126 days or just over four months. The canes are brought from the fields in 6-8 ton trucks which are run alongside the carrier: the contents are hoisted bodily by electric cranes to a sloping platform, from which they are conveyed to a carrier by means of a mechanical rake. Of 77 factories there are eight with 14-roller mills, eleven 12-roller, twenty-four 11-roller, thirty-three 9-roller and only one 8-roller.

The sugar-house processes are ordinary defecation (lime), sulphitation (lime and sulphurous acid), and carbonatation (lime and carbonic acid); and, in 1919, the proportions of these in the factories were 49 per cent., 38 per cent. and 13 per cent. respectively. Careful boiling and vacuum pan work, together with slow cooling in the crystallizers has, in Java, secured a high yield of sugar and a reduction of the quantity of molasses. The largest factory in Java produced, in 1918, 44,386 tons of sugar, and its progress from 1915 to 1918 is shown in a table from which the following is taken. The cane crushed rose from 362,077 tons to 407,955: the sugar produced from 24,332 tons to 44,386: the parts sucrose in 100 cane from 9.0 to 12.76: the parts sugar obtained per 100 cane from 6.72 to 10.88: and the sugar lost or left in the molasses in 100 cane was reduced from 2.28 parts to 1.88. "It will be observed" the Committee remarks "that the cane worked up in 1918 was so much better than that of 1915 and the efficiency of the factory had so much improved that, although only 12.7 per cent. more cane was crushed 82.4 per cent. more sugar was produced." An interesting indication of the progress made in the working of the Java factories as a whole is shown in another table, where averages are given of returns from 138 to 143 factories during the same years, the improvement being steadily progressive under each heading from year to year. The fibre was reduced from 13.26 to 12.99 per 100 parts of cane and the parts sucrose increased from 11.63 to 13.63: the purity of the mixed juice rose from 82.0 to 86.5, while the parts glucose per 100 mixed juice fell from 1.32 to 1.0: the purity of the clarified juice rose from 83.5 to 87.9: the parts sugar obtained per 100 parts cane rose from 9.36 to 11.32 and the parts molasses fell from 3.28 to 2.78 (2.73 in 1917): the number of factories working with cane with 13 parts or more of sucrose per 100 cane rose from 8 to 102 (or 5.80 per cent. to 71.33 per cent.), and the number of factories working on cane with 10 parts or less sucrose per 100 cane fell from 10 to 0.

Labour.—The matter of labour is simplified by the denseness of the population. Java, with 50,000 square miles of area has some 34 millions of people. The labour is entirely voluntary and the present rates are 8 annas for men, 5½ for women and 4 annas for children. Hence the land owners secure a reasonable rent for their land together with sufficient continuous employment to yield an income equal to that

which they would have got if they cultivated the land themselves; and those who cultivate their own lands have a market for their labour during the milling season. In the factories the skilled labour is usually in the hands of the Chinese, who receive 10 as. to Rs 2 per day, while the unskilled labour is supplied by Javanese at 7½ to 9 annas.¹

The Committee concludes this chapter on Java as follows: "Whilst there can be no doubt that, as the result of the traditions of the forced culture system, the Java sugar industry has had exceptional advantages in securing land and labour for cane production, it is equally unquestionable that these alone would not have been sufficient to ensure it the commanding position it at present holds. This has been secured by an admirable organization for mutual assistance in all directions, above all in regard to research, generous expenditure in which it is recognized to be a most profitable investment, and by the adoption of methods of cultivation and manufacture on which it would be difficult to improve, carried out under highly trained and well paid supervision. The sugar industry in Java was certainly not in a more favourable position for commanding land and labour in 1918 than in 1894 but, whereas the outturn of sugar in 1894 was 2.81 tons per acre, in 1918 it was 4.34 tons. In 1919 it fell to 3.86 tons but, owing to prolonged drought, the circumstances of the latter year were exceptional. The result is, as Mr. KEATINGE, Director of Agriculture in Bombay, stated in 1914, that Java sugar dominates the Eastern markets, and that not only is the industry able to dispense with any protection, subsidy or assistance from Government, but it successfully forces its way through hostile tariffs and pays high dividends on invested capital.

"We have endeavoured to give as accurate a picture as possible of the present conditions of the Java sugar industry. It must, however, be remarked in conclusion that many of the conditions are undergoing rapid and material change. Costs both of cultivation and manufacture are rising, labour difficulties are increasingly felt and political developments threaten to affect the hitherto amicable relations between the factories and the land owners. The industry is thus not entirely secure in the position it has so successfully established, and its difficulties and problems appear likely to multiply rather than to diminish in the years that lie before it."

C. A. B.

The Cultivation of Sugar Cane and the Manufacture of Raw Sugar in the Philippine Islands.

By J. T. J. CROOKS.

For many years sugar cane has been grown in the Philippine Islands, chiefly on the islands of Negros, Panay, Mindoro and Luzon. Each farm or *hacienda* had its own small factory, where a low grade muscovado was manufactured by the old-fashioned open kettle process. This muscovado sugar has always had a ready market amongst the Chinese, but at a very much lower price than what could be obtained for Centrifugal sugar of 96° polarization. Only in the most recent years has Centrifugal sugar been made in these islands, and this by but three or four modern centrals, controlled by American and Spanish capital.

However, since the boom of the sugar industry during the war, the prevailing high prices of sugar have set the *hacenderos* off speculating, and they have combined together in several of the districts, principally on the island of Negros, formed companies, and with the aid of large loans from the Philippine National

¹ See footnote on page 495.

The Cultivation of Sugar Cane, etc., in the Philippine Islands.

Bank, have bought large modern centrals which are quite up to date in every way and have sufficient capacity for a great extension of planting area. These centrals are mostly worked on a percentage basis, that is, 50 per cent. of the sugar made goes to the owners of the centrals and 50 per cent. goes to the *hacendero* supplying the cane. In some cases the percentage varies, some on the 40 per cent. and 60 per cent. and some on the 45 per cent. and 55 per cent. basis. The companies owning the centrals supply the railroad to the *haciendas*, and haul the cane to the mills at their expense. They also agree to store the sugar made for a reasonable time, and when the *hacendero* has sold his share, the company transports the sugar to its own wharfs for shipment free of cost to the *hacendero*.

While the price of sugar was high everything looked rosy for these companies, as they were able to get further advances from the banks to pay their working expenses, and the profits on the sugar would have been ample for the payment of the high rate of interest charged by the bank for the money borrowed. When the price of sugar dropped so suddenly (from 50 pesos to 12 pesos a picul), money for current expenses was extremely hard to obtain, and as these companies have absolutely no reserve capital, and the market value of their centrals is now so much lower than when they purchased them (which was done when prices were absolutely top notch), these companies are facing absolute ruin. To obtain the large sums necessary for the purchase of those large centrals, the individual *hacenderos*, who are the shareholders of these companies, have had in a large percentage of cases to mortgage their *haciendas* and other properties to the bank.

The cane cultivated in the Philippine Islands is mostly native cane, and very little has been done to improve the crops either by fertilization or new varieties. On the Island of Mindoro, the owners of the Central are also the owners of the plantation, and there an attempt has been made to improve the supply of cane, both by fertilization and new varieties, with very good results indeed. The majority of the other cane grown is farmed without any scientific treatment whatever.

The Philippine Islands have an ideal climate, and there is a great supply of suitable land for the growing of sugar cane, but the one great drawback is the labour question. There is a very large native Filipino population, but they are an indolent lazy people who prefer not to work, even though they are paid from one and a half to two pesos (3s. to 4s.) a day. Imported labour, such as the Chinese, is forbidden by the Government, so that the sugar industry is at the mercy of the natives.

Capital is sadly needed in the Philippines for all the agricultural industries; and this is not forthcoming owing to the disturbed political conditions prevailing. Everywhere in these islands is heard the phrase "The Philippines for the Filipinos," and the present agitation is all for self-government. All these facts make the American investors hold back from bringing money into the islands.

This year the *hacendero* has had another hardship to face, due to the ravages caused by the dread disease rinderpest, which has wrought havoc amongst the carabou or water buffalo, which are used for ploughing and as beasts of burden. In many cases over fifty per cent. have died, and these animals are worth from 300 to 400 pesos (£30 to £40) per head. However, the *hacendero* is at last waking up and is adding up-to-date motor tractors to his stock; but these are no good in ploughing between the rows of young cane, which task must be done by animals.

The foregoing will give the reader some idea of the troubles which are facing the sugar industry in the Philippine Islands; this at the best is only in its infancy, and it cannot possibly succeed without more capital and better labour conditions combined with scientific control in the fields.

Meditations on Trapology.

The Rôle of the Steam Trap in the Sugar Factory.

By J. O. FRAZIER.,

Sugar Engineer, New Orleans.

V.

In practically all return steam traps the live steam connexion will be found of such size as might indicate a very considerable steam consumption. Such size is not based, however, upon real steam consumption, but is for the purpose of equalizing the pressure in the chamber with that of the boilers in the shortest practicable time; thus being a time saver.

To make this fact more appreciable, we may take equal volumes of steam and water and compare the weights, which are basic measures of mass. If we have, for illustration, a trap chamber whose water-filling content be 3.84 cub. ft., which the steam tables show us, at 100 lbs. weigh 1 lb., and consider that 3.84 cub. ft. of water weigh, say, 50 lbs. per cub. ft., at the temperature due to 100 lbs. pressure we will have a water weight of 192 lbs., which is 1 lb. of steam to 192 lbs. of water. This is only closely approximate to the real steam value, as there are small losses by condensation within the chamber.

The adaptability of the return steam trap to other than that of boiler-feeding service involves some interesting and often useful applications. Two of these are shown in Figs. 9 and 10, and are adaptations to the pumping of finished syrup from the multiple effect and that of ordinary water pumping respectively. The whole range of return trap operation is basically one of relative pressures. In its simplest expression the steam above the water in the trap chamber is the piston, urging discharge, and a head or pressure at the inlet the equivalent of suction.

In Fig. 9 is a partial outline of the last vessel of a multiple effect, and the application of a return trap to the withdrawal of the finished syrup. In this case the displacement steam, after a discharge of a chamber load of syrup, is directed immediately into the regular condenser marked *Con.*, through the pipe *V*. Under these conditions, then, the displacement steam is just a small bit worse than thrown away, because it must be condensed along with the final vapours. Under the conditions then existing, the trap chamber is connected with its vent valve wide open to the point in the apparatus of highest vacuum. The full head of liquor then becomes available as an inflow force. Practically the same conditions apply in pumping, except the frequent stuffing box leakage which pertains to the usual run of pumps. The inlet from the effect is shown at *I*, and the discharge at *D*, while the steam equalizer—in this case a real piston—is at *S*. Having the usual house live steam pressure in the chamber will, of course, deliver the syrup to any point within pressure range.

The interesting and utilitarian feature of such equipment is that the number of vacuums necessary is as the number of trap charges. In most cases the size of trap adapted to the work would contain a displacement equal to 25 to 40 strokes of the equivalent pump, so the strokes of the trap might be one, while that of a pump be, say, 30. Each rod end of the pump stroke involves the possibility of air leakage at the stuffing box, unless water sealed as some are and all should be. However, these do not always remain sealed.

It has been found that the alternating steam bath, to which the inner walls of the chamber are subjected, effectually prevents crystallization, and that the diluting effect of condensation on the surface of the syrup is quite imperceptible.

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The application of live steam on the surface of even a very cold liquor in an enclosure will result in a very small and rapid condensation of a very thin film on the surface, having the same temperature as that of the steam; being a non-conductor of heat, it will not, however, continue.

The traps shown in both Figs. 9 and 10 are of the same detail type as that shown as Fig. 7 in the previous article; both are return traps of that type. In all makes of return traps the "vent" or exhaust valve is a common feature.

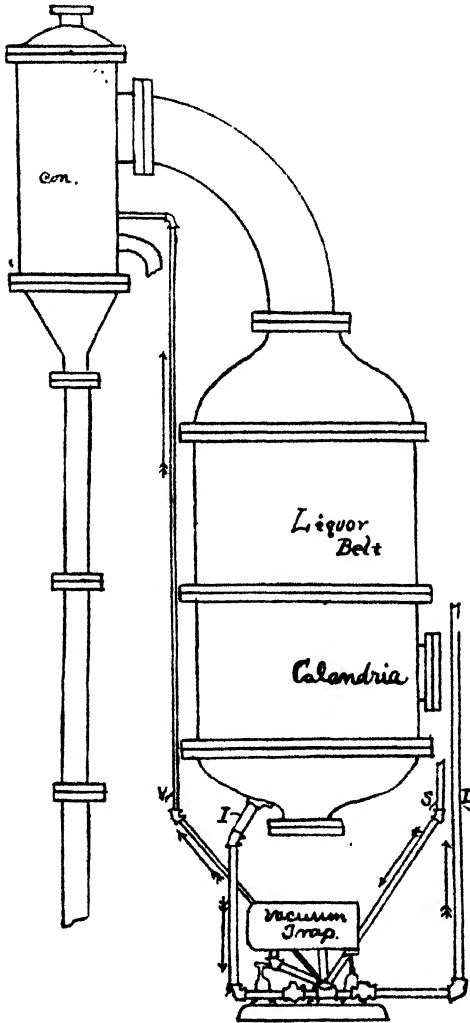


FIG. 9.

In the type shown this valve is loaded against the discharging live steam pressure in the chamber by a weight. This valve is opened by a mechanical connexion with the main moving element at the proper intervals for exhaust, which are after each discharge of a chamberful.

The filling line of practically all return steam traps is slightly less than a chamber full, as shown in the previous Fig. 7. Such usual non-filled space is not far from 5 per cent. of chamber capacity. One result of this is that the real steam volume used becomes about 5 per cent. greater than that of the water handled. This vacant space is for the especial purpose of permitting a slightly heavier load in case of any laggardness toward tilting when filled to the regular balance line. A similar modification of complete discharge is also the custom, particularly to provide a water "seal" over the discharge opening, and the entrance of the equalizing steam into the water discharge system, also, is of moderate value in the extreme lightening of the load to additionally assure a reversal of trap movement.

In Fig. 10 is shown an application of the same type of return with the modification of the injection

spray shown, and used for ordinary lift and force pumping. The flexible hose connexion shown is connected with the discharge *D*, or with other source of condensing water supply, and is provided with a stock-check valve *V*. This serves the double purpose of a check against the chamber pressure at the proper time, and of an inlet for the condensing water. The operation of the injection *I* is automatic; it is closed against steam pressure in the chamber as an ordinary check valve, and opened by the vacuum within, plus the head of

water through *D*. In such application, as a condenser trap the injection of water is through the regulator vent valve connexion. The range of lift, through the suction pipe shown is, of course, in proportion to the same as with equal conditions of vacuum and height of lift with the ordinary steam pump. With tight-stuffing boxes on the trunnions very considerable lifts are practicable. The relative weights of condensing water required are, of course, the same as those usual for equal temperature differences between steam and condensing water, but the volume of water is only a very small fraction of the total delivery.

The useful range for application of the condenser trap is rather less interesting than its novelty as an engineering problem. However, as the general run of steam traps operate with considerably less steam, attention and up-keep cost, there are instances of isolated pump locations for a moderate quantity of water or other liquids, where such equipment may be very profitable and satisfactory.

The range of steam trap service partially covered by these articles consists of four somewhat distinct types: the return trap, applying to boiler feeding and other services; the vacuum trap for withdrawal of liquids from vacuum spaces, either by

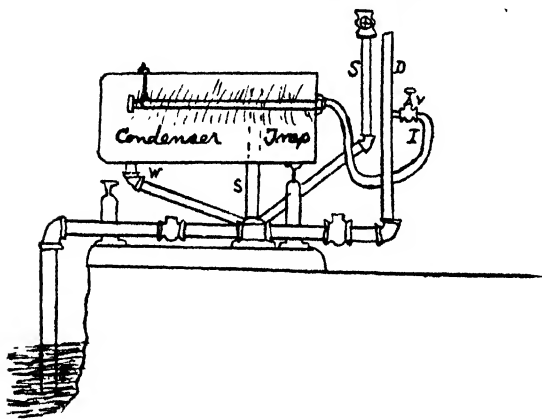


FIG. 10.

higher vacuum or by liquor head, or both; the condenser trap, as a lift and force pump; and the non-return trap, simply a variable outlet for condensation. This range of service is common to the product of all our largest American makers of steam traps; exclusiveness, for a particular kind, is only one of minor mechanical detail.

Regarding the temperature performance of the boiler feeding return trap, on which hinges its largest claim as an economic device, the follow-

ing applies: Many of the writer's observations have shown vacuum pan coil condensation, with 80 to 90 lbs. pressure delivered through the return trap at well above 300°F., that from 40 to 50 lbs. coil pressure at 275° to 290°F. It is very probable that the high and low pressure of the average large sugar factory may thus be delivered into the boilers at as high as 250°F. against the probable average of about 180°. This will, however, hinge very largely on the proportions of high and low pressure condensations. An interesting and useful feature of such delivery would be the very immediate near balance of condensation supply with that of steam demand at the boilers.

Should such delivery result in a gain of 70°F. in all the feed water, it would approximate 7 per cent. of the total fuel requirement; if the bagasse furnishes 75 per cent. of the total fuel, the 7 per cent. becomes 28 per cent. of the excess fuel.

The interesting phenomenon of "flash" heat comes into play in the operation of the return steam trap on boiler feed service, and, theoretically at least, to its disadvantage. This in degree is, of course, in such proportions as the trap chamber pressure differs from that of the condensation source. Such "flash" is the effort to part with excess heat above that due to the chamber pressure. Conditions limiting flash quantity are confinement and the short time exposure to

Meditations on Trapology.

pressure release, that of the filling periods of the chamber. All flash is a proportionate resistance to water inflow; if into the open, the flash heat would be lost; if into the effect heat belt, it will be utilized; in all cases it represents its equivalent water loss from the total trap delivery. These quantities are very moderate, but are fixed conditions of such service.

In all return trap boiler feeding the inlet and outlet check valves of the trap had best be below the boiler water level, as shown in Fig. 7. Should these be above such level, and anything should happen so that steam admission into the chamber be continued until such chamber be entirely emptied, steam will then flow into the boiler water delivery system. If the checks be near the trap level they will become bathed in live steam; should a subsequent discharge of water occur from the same or another trap, there will be a water hammer in the area in which the checks are located, as the water in the system would settle to that of the boiler water line. Should the same conditions come about and the checks be below boiler water level, they will remain submerged and the water hammer will occur, with little or no damage, in an area of plain piping.

A separate feed system is necessary with all return traps from that used by other feed means. No pressure greater than that of trap head is available for trap feed, under usual conditions; with pumps the pressure in the system is often observed to be from 5 to 20 lbs. higher than boiler pressure.

It will readily be appreciated that if the boiler plant carry two pressures, equalizing steam for return steam traps may be had from the highest pressure, traps may be located on the ground and still feed those boilers whose pressure is lower, if there is sufficient difference, which may be taken roughly at as low as 10 lbs.

It is hoped that this series may have covered the fundamentals of the subject and such detail as may suggest to those interested further consideration of refinement of detail not possible to discuss within the limits of permissible space.

(Concluded.)

It has been found that if, in the manufacture of filter-paper, kieselguhr is incorporated with the pulp, a material is obtained which is capable of retaining the finest precipitates, calcium oxalate, for example, when thrown down in the cold.

A motor fuel containing alcohol was patented in 1918 in Mauritius by Mr. ALBERT PAOLETTI,¹ and has been produced in a small plant making about 300 gallons per day, the retail price being said to be 1s. 4d. per gallon in bulk. It is known locally as "Sylvestrique," and according to the specification of the patent consists of a mixture of 1000 c.c. of denatured ethyl alcohol at 36° Cartier (about 90 per cent. by volume) and 25 c.c. of sylvestrene or oil of turpentine.

Back-pressure systems of using steam (which have been in practice in the cane sugar industry for very many years past) are being advocated by writers on fuel economy for adoption in chemical factories in this country. Mr D. BROWNLIE, lecturing recently at the Municipal College of Technology, pointed out that when coal was used to generate steam, and this steam was then used in a condensing engine or turbine, the nett result was that only about 8 per cent. of the energy of the coal was actually used to produce power, and about 64 per cent. of the heat went down the river as cooling water. In the "modern back-pressure or passout system," however, the steam was generated at a high pressure, passed through an engine or turbine, and taken out at the end at low pressure, say 40 lb., still containing the whole of the latent heat for use subsequently in process work. This resulted in "an enormous economy," and instances were given in which the coal bill of chemical works had been reduced as much as 40 and sometimes as much as 60 per cent. by utilizing the steam in this way.

¹ Mauritius Patent, No. 282 of 1918.

Further Studies on some Fungi and the Deterioration of Sugar.¹

By PAUL A. VAN DER BIJL, M.A., D.Sc., F.L.S.

In a previous publication² we have dealt with some fungi and bacteria responsible for the deterioration of sugars during storage; and the present paper is in part a continuation of the work thus started. It also reports experiments on fungi isolated from sugars and sugar solutions under different conditions.

Not having access to the necessary literature for enabling the specific identifications of a number of isolations from "sweating" sugars to be made, Dr. CHARLES THOM, of the Bureau of Chemistry, U.S. Department of Agriculture, kindly co-operated and undertook to identify them, for which service we are greatly indebted to him.

IDENTIFICATION OF VARIOUS FUNGI.

The fungi dealt with are *Penicillium* spp. and *Aspergillus* spp., and I cannot do better than append below the data on them as submitted to me by Dr. THOM:—

"Isolation No. 1.—*Penicillium divaricatum* of my paper. This organism is widely distributed, especially in the soil and probably is more truly a *Spicaria*. Whether it can be identified with some other previously described forms or not, I have never determined.

"Isolation No. 2.—A strain of the *Aspergillus repens-glucus* group.

"Isolation No. 3.—Closely related to No. 2. In dealing with this particular group of organisms, there are undoubtedly a number of strains, races or species which differ materially. MANGIN discussed the group some years ago, establishing three forms, *Aspergillus amstelodami*, *A. repens* Debary, and *A. herbariorum*. More recently BAINIER and SARTORY have described a series of forms out of this same lot of material. I have collected the material to make another survey of this group, but have not found time to reach any conclusions. The ascospores of your culture have the furrow with a wing on each side which makes a diagnostic difference from the typical *A. repens*, but the spore is too small for the *A. herbariorum*.

"Isolation Nos. 4 and 6.—These strains are closely related, belonging to the *Penicillium luteum-purpurogenum* series. The conidial area becomes a deep, dark green and the agar where cane sugar is present becomes a deep purple red. This would indicate a fairly close relationship to *P. purpurogenum*.

"Isolation No. 5.—*Aspergillus niger*.—My culture from your tube showed two strains of black *Aspergillus*. The morphology of the head differed very little in the two strains. The measurements of the spore, sterigmata and vesicle correspond fairly closely with the typical *A. niger* of VAN TIEGHEM, but one of the cultures has very short stalks, approximately 500 m.m. in length; the other consistently produces stalks several m.m. long. This is an interesting variation, but every gradation between these forms seems to be found upon comparison of large numbers of cultures from other sources.

"Isolation No. 7.—*Aspergillus terreus* as described by us in the *American Journal of Botany*.

"Isolation No. 8.—*Aspergillus fumigatus* in fairly typical form."

¹ Editorial summary of Science Bulletin No. 18, published by the Department of Agriculture, Pretoria, Union of South Africa, price 3d.

² Science Bulletin No. 12, Department of Agriculture, Pretoria, Union of South Africa; I.S.J., 1921, 320-324.

Further Studies on some Fungi and the Deterioration of Sugar.

INFECTION OF SUGAR SOLUTIONS AND SUGAR CRYSTALS.

These fungi were inoculated into (a) a previously clarified and sterilized solution of mill sugar at 20° Brix, and (b) some Dox solution.¹ In the case of all the fungi examined, these solutions were found to invert sucrose, a greater or less amount of acid being formed at the same time. *Aspergillus terreus*, *Aspergillus* Isolation No. 2, and *A.* Isolation No. 3 were foremost in the formation of invert sugar; while *A. niger* produced most acid in these tests.

Another series of experiments was carried out in which 20 grms. of refined sugar crystals were sterilized, inoculated with the fungi, moistened by spraying with four per cent. of sterilized distilled water, and incubated at 28°C. Here the fungi producing the largest amounts of invert sugar were: *A.* Isolation No. 2, *A.* Isolation No. 3, and *A. niger*.

EFFECT OF NITROGENOUS MATTER ON THE INVERSION.

Micro-organisms responsible for the deterioration of raw sugars in storage have a relatively low nutritive requirement, so far as nitrogenous and mineral foods are concerned. It was decided to grow some of the fungi in sugar solutions to which different nitrogenous compounds, as asparagin, peptone, ammonium tartrate had been added, in order to see to what extent the addition of these substances was capable of favouring the growth and the formation of invert sugar.

The result of these experiments (tabulated in the original paper) leads to the conclusion that the presence of the nitrogenous and mineral food substances in sugar solutions can be said to favour inversion by the fungi examined, namely, *A. fumigatus*, *A. repens-glancus*, and *A. niger*. This result, however, may not apply in the case of raw sugars, in which case the addition of foreign substances may serve to increase the density of the moisture film around the crystals, and thus make the growth of the micro-organisms in this film more difficult. This is a point requiring further investigation.

GROWTH IN SUGAR SOLUTIONS OF DIFFERENT DENSITY.

An important quality of a micro-organism responsible for the deterioration of sugar in storage is its capability of growth in high concentrations. In order to examine this point, solutions of refined sugar from 10° to 72° Brix were inoculated with the various fungi, and the amount of invert sugar and acid formed was determined after three weeks. *A. niger* and *A. terreus* caused invert sugar and acid formation in liquors at 65·5°, but not above. Growth at 72° Brix was observed only in the case of one organism, namely the *Aspergillus* Isolation No. 2. In a few instances in high concentration the inoculated solutions were found at the end of the time stated to contain less invert sugar than the control liquor. The conditions in these cases, while not preventing the growth of the fungi, appear to inhibit their inverting power; and the necessary energy for their growth is obtained by utilizing the invert sugar originally present in the medium. A similar result is noted when the fungi are grown in sugar solutions of varying alkalinity.

INFLUENCE OF ACIDITY OR ALKALINITY UPON INVERSION.

To test the inverting power of the fungi under consideration in solutions of different reaction, 200 c.c. lots of a 30° Brix solution of raw sugar, after clarification with alumina, were sterilized, and varying amounts of N/1 hydrochloric acid and sodium hydroxide added while still hot. These solutions were infected with

¹ Sodium nitrate, 1; potassium nitrate, 1; potassium phosphate, 0·5; magnesium sulphate, 0·01; potassium chloride, 0·01; ferrous sulphate, 0·01; sugar, 30; and water, 1000.

the fungi, and after two weeks' growth the amount of invert sugar present was determined.

On comparing the figures thus obtained, it was at once seen that inversion was greater in the acid series. Further it was noticed that in the alkaline series, though inversion had taken place, it was generally less than in the control of the same series. Alkali therefore retards inversion. In a few instances, less invert sugar was found than was originally present; but possibly in these cases the fungi utilized the invert sugar present for growth before starting further inversion.

INFLUENCE OF LEVULOSE AND HYGROSCOPIC SALTS.

In addition to the decomposition products of dextrose and their alkali salts, the levulose present increases the hygroscopic nature of a raw sugar. Calcium chloride and magnesium chloride also enhance this effect. Small quantities of these substances were added to refined sugar, and the increase in moisture absorption was determined. A marked increase in weight due to absorbed moisture resulted, which observation has a distinct bearing on the question of the deterioration of sugars. Factors which make them liable to absorb moisture from the atmosphere would indirectly favour the growth of micro-organisms by reducing the density of the film of molasses around the crystals. It may be that the reaction between sugar and some of these substances is a contact reaction, the substances absorbing moisture, passing it on to the sugar, and being in its turn left to absorb more moisture. Such a suggestion has been made by DEERR and NORRIS.

INFLUENCE OF DIFFERENT MOISTURE CONTENTS ON DETERIORATION.

To examine the relation between the moisture content of the sugar and its deterioration by fungi, 20 grms. of refined sugar were sterilized, inoculated with the fungi, and different amounts of sterilized distilled water evenly distributed over them, rubber tubing being tied over the cotton-wool plugging the flasks used, in order to prevent as far as possible loss of moisture by evaporation. After incubating at 30°C. for one month, the invert sugar content was determined.

It was evident from the results obtained that in every instance the deterioration increased with the amount of water added. Even with only 0.5 per cent. of moisture the deterioration was considerable. It has been previously pointed out that, whereas in refined sugars the total moisture present is the only criterion of safety, in molasses sugar and lower-grade sugars the "factor of safety," i.e., the ratio of water to solids non-sucrose, or the density of the molasses film around the crystals, comes into operation.

EFFECT OF PARTIAL STERILIZATION ON DETERIORATION.

In our previous contribution² we showed that the fungi are not resistant to heat, and the possibility of sterilizing raw sugars was mentioned, though at the same time the fact that they would be liable to re-infection by micro-organisms was pointed out. To determine the effect of sterilization on the subsequent deterioration, 20 grms. of raw sugar were placed in previously sterilized flasks, which were placed in an oven for varying periods of time. On removing the flasks, about four per cent. of sterilized water was evenly distributed over the sugars, the flasks closed by rubber tubing, and incubated at 30°C. for one month. On determining the amount of invert sugar formed at the end of that time in each test, the conclusion was that by heating the sugar at 70°C. for 15 mins., or at 80°C. for 10 mins., its power of subsequent deterioration was considerably decreased.

¹ Bull. 21, Agric. H.S.P.A.

² I.S.J., 1921, 323.

Further Studies on some Fungi and the Deterioration of Sugar.

COOL STORAGE FOR PREVENTING DETERIORATION.

It is generally known that the growth of micro-organisms is retarded at low temperatures. In an experiment, 20 grm. lots of sugar were sterilized, infected with the fungi under consideration, and treated with about three per cent. of sterilized water. One series of tests was incubated at 28°C., and the other at 13–20°C. (in an ice-chest). On examining the amount of invert sugar 46 days after inoculation, it was found that in every instance there was a greater deterioration at the higher temperature. These results are instructive.

CONCLUSIONS.

We have thus far dealt primarily with micro-organisms isolated from sugars, and have seen that by secreting a ferment known as invertase, these are capable of inverting sucrose with the formation of the more hygroscopic "glucose." They thus have a bearing on the absorption of moisture from the atmosphere by the sugar in storage.

Having demonstrated the fact that the fungi and bacteria secrete the same ferment, it is at once evident that the growth of these micro-organisms in gutters through which sugar juices are conveyed will be continually secreting this ferment which would contribute to inversion.

In the clarification of the juice with lime and sulphur dioxide the largest percentage of these micro-organisms is removed. OWEN¹ calculated in Louisiana that about 98 per cent. of the micro-organisms present are removed during defecation.

Further, we have noted that of the two groups of micro-organisms, fungi or moulds and bacteria, the former is not able to withstand the temperature of boiling water, and the latter in their spore stage can withstand this temperature for long periods. We have again noted that in the deterioration of crystal sugar the moulds are the more important and the bacteria probably play a part only when excessive amounts of water are present.

Everything considered, we can assume that after the juice leaves the heaters it will be rid of any moulds it may have contained; and the aim of the manufacturer from this point onwards should be to prevent it from becoming re-infected, as far as practicable. This can only be accomplished by hygienic measures and conditions, that is, by the use of suitable disinfectants, as formalin, sodium bisulphite, and bleaching powder (chloride of lime) for cleaning tanks, gutters, filter bags, etc.² Such measures are more and more realized to be of importance in the sugar industry.

Among the factors which influence the inversion of crystal sugar by micro-organisms, the following are noted: the temperature of the surroundings; the moisture present in the sugar; the humidity of the atmosphere; exposure to infection by micro-organisms at various stages, and especially subsequently to the syrup leaving the evaporators; and the presence of hygroscopic substances in the raw sugar. All these factors can be brought more or less under human control as far as the storage of sugar is concerned; and a little antiseptic wash and attention to hygienic conditions will do much to reduce the micro-organisms growing in store-houses or occurring in mills, and thus diminish sources of infection.

[* * The Editor of the *South African Sugar Journal* having adversely criticised this excellent bulletin of DR. VAN DER BIJL, we would refer the reader to our Notes and Comments for some remarks on the matter.]

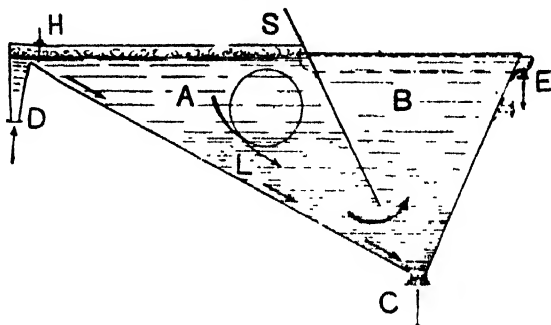
¹ I.S.J., 1919, 334–338.

² See the author's previous paper, I.S.J., 1921, 324.

A New Type of Settling Tank.

A new type of settling tank, which is stated to have been found very successful for the clarification of the waste waters from the diffusion battery and the slice presses of the beet sugar factory, was recently described.¹ It is automatic in action, and is said to yield a liquid of crystal clearness in the case of the waste waters mentioned.

As may be seen from the illustration, it consists of a triangular vessel, divided into two sections, *A* and *B*, by the partition *S*, but not completely, since at the lower part of the partition there is an inter-communicating space. The waste waters enter through the tubulure *D*, the upper part of which is widened in the form of a funnel before it makes its connexion with the section *A* of the tank, the object of this arrangement being to break the force of the inflow and avoid as much as possible the disturbance of the subsiding liquid already present.



After going under the partition *H*, which can be moved to and fro for sweeping the scum into a suitable gutter, the water under treatment passes downwards with gradually decreasing rapidity along the inclined wall *L* of the tank, the coarser solids (as the pulp) rapidly sinking to the bottom, the lighter ones being also gradually carried with a circular movement along the wall towards the bottom. At the lowest part of the tank, the liquid is caused by the partition *S* to move upwards, and at a gradually decreasing rate. In consequence of the very slow rate of flow in the section *B*, the light solids still remaining are almost brought to rest, and have sufficient time to subside, ultimately concentrating in the bottom of the tank, while the clear liquid leaves the tank at the outlet *E*.

This clarified liquid may again be used in the diffusion battery, so that this apparatus would appear to solve the difficult problem of the utilization of the waste waters of the beet factory, a problem to which technologists have devoted considerable attention. Finally the result is that all the solids present in the waste waters collect at the bottom of the apparatus, forming a thick layer there. This layer in fact contributes essentially to the clarification, since it acts as a filter to the still muddy liquid passing through it, though it is not allowed to exceed a certain height, but is run off through the cock *C*. Beyond regulating the rate of flow of the inlet *D* and the mud outlet *C*, the apparatus requires no supervision.

In the draft of the United States Tariff Bill, rare sugars for use in bacteriological purposes, as arabinose, galactose, levulose, dextrose, mannose, raffinose, are protected by a duty of 50 per cent. ad valorem.

¹ *Centr. Zuckerind.*, 1921, 29, No. 33, 940. The tank is described as of the "Mann System," and is constructed by a German firm.

Geerligs' Theory of the Formation of Molasses examined in the Light of the Phase Rule.

In a recent communication of the Java Experiment Station,¹ Dr. W. D. HELDERMAN pointed out that in order to examine the nature, composition, and properties of the molasses resulting from cane sugar manufacture it is of importance to know whether it is possible for sucrose to form double salts, and to learn their composition, if they are formed. In the literature only a few sporadic references respecting them are to be met; and the proof that one is dealing with compounds and not with mixtures of crystals apparently has not been put forward.

With the purpose, therefore, of deciding this important and interesting point, Dr. HELDERMAN has examined the ternary system formed by the three substances, $C_{12}H_{22}O_{11}$, $NaCl$, H_2O ; and in doing this the solubility relations at a constant temperature, the so-called *isotherms*, were studied, the temperature chosen being $30^\circ C.$, which may be taken as the mean degree prevailing in Java.

A brief explanation of the method followed may here be given. If at a certain temperature the solubility of a substance *A* in presence of different amounts of another substance *B* is determined, then, depending upon the amount of *B* added, one will find different solubilities for *A*, which can be represented by a curve

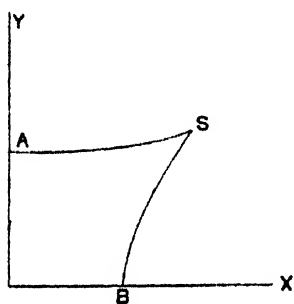


FIG. 1.

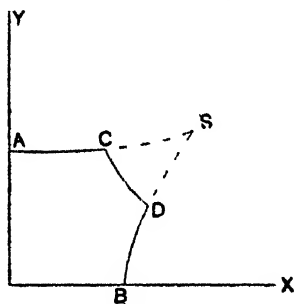


FIG. 2.

having its end-point at that composition at which the solution is saturated by *A* and by *B*. Graphically this is represented in Fig. 1. *Y* shows the amount in grm.-molecules present in a saturated solution of *A*; and *X* the same for *B*. Proceeding from the points *A* and *B* one obtains the solubility curves for *A* and *B* when gradually increasing amounts of *B* and *A* are added to one another. These curves cut at the point *S*, which indicates that composition of the solution at which both components are saturated.

But an entirely different result is represented when the substances *A* and *B* form a stable compound at the temperature chosen. Then, referring to Fig. 2, the solution will be supersaturated at *S* (since the stable system has the smallest and the meta-stable the greatest solubility), and the double salt must precipitate. During the crystallization of the compound, the two single components still present will dissolve, and depending upon whether *A* or *B* is more readily dissolved than the other, then the compound + *B*, or the compound + *A*, originates as the solid phase in equilibrium with the solution, which cases are represented in Fig. 2 by the points *D* and *C* respectively.

If, therefore, the solubility curves of two substances with the addition of gradually increasing amounts of the other be determined, one is able from the

¹ Mededeelingen van het Proefstation voor de Java-Suikerindustrie; *Archief*, 1920, 28, No. 39, 1701-1714.

figure obtained at once to learn whether a compound is formed or not. In this manner the following systems were examined: Sucrose, K_2SO_4 , H_2O ; sucrose, KCl , H_2O ; sucrose, $NaCl$, H_2O ; sucrose, potassium acetate, H_2O ; sucrose, potassium oxalate, H_2O ; and in a later paper¹ also dextrose, KCl , H_2O ; dextrose $NaCl$, H_2O ; and dextrose, K_2SO_4 , H_2O . Details of the numerous and laborious experiments (apparently carried out with extreme care and precaution) will be found in the original papers.

It was concluded that "in none of the cases examined was any proof to be found in the form of the isotherms or the slope of the cooling curves of the existence of compounds between sucrose, salts, and water."

In order to render this conclusion more complete, Dr. HELDERMAN endeavoured to prepare a compound of sucrose and KCl by proceeding in a similar way to that followed by PELIGOT.² A solution containing 34.2 grms. of sucrose and 7.5 grms. of KCl in 20 c.c. of water were set aside in a desiccator; but after three weeks no sign of crystallization appeared. On adding a quantity of 96 per cent. alcohol, the system separated into two layers, and a few days later the lower one crystallized out. Under the microscope the crop proved to be composed of two sorts of crystals, the larger of the form of sugar crystals, and the smaller of no distinct form. By sieving and sorting, the two kinds were separated from one another, and were analysed separately, the results for the sucrose, KCl , and H_2O being 89.78, 8.52, 1.78; and 41.17, 57.00, 1.23 respectively. Duplicate determinations gave values differing by more than 2.3 per cent., so that a homogeneous composition of the product was out of the question.

DR. GEERLIGS' REPLY.

Dr. PRINSEN GEERLIGS published a reply³ in which he stated that the conclusion arrived at by Dr. HELDERMAN with the aid of the phase rule, that neither sucrose nor dextrose is capable of forming compounds with salts, had caused him some astonishment. When elaborating his theory of the formation of molasses,⁴ he had founded his considerations on the basis that sucrose, dextrose and levulose were certainly able to unite with salts and water of crystallization, which basis depended, not upon an indefinite hypothesis, but upon demonstrated facts.

It is very well possible that the method applied by Dr. HELDERMAN is not capable of proving that such compounds exist; whereas direct experiment since a number of years has shown that the sugars mentioned are really capable of forming well-defined compounds with salts and water. Thirty-five years ago in his student days he obtained at Amsterdam very fine crystals of glucose-sodium chloride; and he very well remembers having seen beautiful crystals of sucrose-sodium chloride, and especially of sucrose-sodium iodide in the Laboratory of the Ministry of Finance in the East India Building in Amsterdam, the latter crystals having reached the size of several centimetres.

In MAUMENÉ's book⁵ a description of the preparation and the properties of sucrose-sodium chloride with two molecules of water will be found. Crystals having dimensions of 15 mm. have been obtained, and the form described by DES CLOIZEAUX, who explained that they were ortho-rhombic, and wholly different from sucrose crystals. Their composition was: sucrose, 78.35; $NaCl$, 13.40; and H_2O , 8.25, corresponding to the formula: $(C_{12}H_{22}O_{11})NaCl + 2H_2O$. MAUMENÉ

¹ *Archief*, 1920, 28, No. 51, 2305-2310.

² *Ann. d. Pharm.*, 30, 71. Other references to the preparation of double salts cited by Dr. HELDERMAN are: GILL, *Verichte*, 4, 417; VIOLETTE, *Bull. Soc. Chim.*, 19, 407; MAUMENÉ, *ibid.*, 19, 289.

³ *Archief*, 1921, 29, 567-571.

⁴ "Cane Sugar and its Manufacture," pages 301-317.

⁵ "Traité de la Fabrication du Sucre." Part I, page 73.

Geerligs' Theory of the Formation of Molasses.

mentioned yet other compounds of sucrose, namely, those with KI and KBr. STENHOUSE¹ obtained a sodium bromide compound with dextrose, this being confirmed by TRAUBE,² who also prepared the dextrose-sodium iodide compound. TOLLENS and SMITH³ recorded the formation of a number of compounds of levulose and halogen compounds of an alkaline nature, all crystallizing well, and all soluble in water and alcohol. Several of these compounds exhibited mutarotation, the opticity finally becoming the same as that of the levulose present. HERZFELD and WINTER⁴ prepared double compounds of levulose and lead chloride and lead nitrate, one molecule of the sugar uniting with two of the salt.

All these examples, Dr. GEERLIGS concluded, prove that compounds between sugars and salts are very well possible.

DR. HELDERMAN'S REPLY.

After reading Dr. GEERLIGS' remarks, Dr. HELDERMAN⁵ said that he had thoroughly studied the older contributions on sugar-salt compounds, as well as those referred to in his first paper; and the outstanding position of these investigators had led him to exercise great care in drawing conclusions from the results obtained. His analyses, however, left no doubt respecting the conclusion to be drawn from them, namely, that in the cases examined of the ternary system: sucrose-salt-water, at 30°C., no compound as stable solid phase in equilibrium with its saturated solution is formed.

He added that Dr. GEERLIGS in his article dealt with an entirely different question. Dr. HELDERMAN does not deny the possibility of obtaining crystallized compounds between sucrose and salts in some way or other, for the simple reason that this is of no importance to the molasses question. In molasses one has to deal with solutions of compounds and not with compounds in the crystalline state. His investigations concerned the point whether at 30°C. sugars give compounds which occur stably as a solid phase in equilibrium with their saturated solutions; and in all the cases examined a negative reply was given.

The sugar-salt preparations obtained by the older investigators, mentioned by GEERLIGS in his article, might well have been compounds, though proof of this is lacking. The finding of stoichiometric relationship alone should, however, never be accepted as proof of the occurrence of a compound. Neither should the fact that the crystalline form of the assumed compound differs from that of sucrose be taken as proof of the existence of a compound between the two components. It is well known that when two substances crystallize together, the crystalline form of the mixture is wholly different from that of either of the single salts, and examples of this influence are cited.

Concluding, Dr. HELDERMAN says that the *summa summarum* is that PRINSEN GEERLIGS' article gives no single reason why one should modify the conclusion that in the cases examined at 30°C. no compounds occur which are stable in the case of their saturated solutions. It is hoped in a publication shortly to appear to confirm this conclusion by quite a different method.

A motor tractor Gold Medal Competition was recently held in Ceylon under Government auspices, in which four makes took part. These were the Saunderson 23-25 h.p.; the Avery 7-14 h.p.; the Cletrac 12-20 h.p.; and the Fordson 22 h.p. The prize was won by the Cletrac, a caterpillar tractor made by the CLEVELAND TRACTOR COMPANY of Cleveland, Ohio.

¹ Liebig's Annalen, 189, 286.

² Zeitsch. für Kristallographie, 23, 47.

³ Zeitsch. für die Zuckerindustrie, 80, 521. ⁴ Ibid., 36, 128.

⁵ Archief, 1921, 29, 571-574.

Technical Data relating to French Beet Sugar Factories.¹

	1912-13.	1917-18.	1919-20.
Factories in operation	213 ..	61 ..	60
Raperies	103 ..	38 ..	37
Juice pipe-line, kilom.	878 ..	410 ..	398
Boilers, French type.	104 ..	24 ..	42
,, fire-tube type	318 ..	167 ..	164
,, semi-tubular type	1,221 ..	390 ..	364
Total boiler heating surface, sq. m.	256,499 ..	98,153 ..	97,529
Char (bone-black) filters in use	153 ..	43 ..	43
Mechanical filters	1,815 ..	562 ..	563
Filter-presses	1,768 ..	517 ..	527
Total workmen employed, while slicing	34,314 ..	13,520 ..	13,519
,, ,, ,, after slicing	5,736 ..	2,045 ..	1,982
Total coal used during the campaign, metric tons.	784,071 ..	217,241 ..	175,584
Coal used per metric ton of roots in kilos.	117 ..	136 ..	146
Average price per metric ton of coal, francs.	25.31 ..	101.89 ..	73.00
,, ,, of the roots, in francs per metric ton	30.28 ..	57.40 ..	79.11
,, ,, of the pulp, ,, ,,	4.26 ..	4.48 ..	6.01
,, daily wages, men	4.56 ..	7.07 ..	13.70
,, ,, ,, women.	2.49 ..	4.61 ..	8.13
,, ,, ,, children	1.97 ..	4.23 ..	6.41
Hectares cultivated	229,275 ..	66,305 ..	62,259
Beets sliced, metric tons	6,674,022 ..	1,596,321 ..	1,202,447
Sugar made, as refined, tons ²	877,656 ..	200,264 ..	155,101
Yield of sugar, per cent. roots	13.15 ..	12.54 ..	12.89
Molasses, tons	258,253 ..	60,882 ..	49,960
Molasses per 100 kg. of roots	3.87 ..	3.81 ..	4.15
Pulp produced, metric tons	3,188,595 ..	772,133 ..	586,898
Sugar produced per factory	4,120 ..	3,283 ..	2,586
Beets sliced per factory	31,333 ..	26,168 ..	20,040
,, ,, ,, and per day	410 ..	422 ..	421
Factories using milk-of-lime	— ..	56 ..	53
,, ,, lime in powder	— ..	3 ..	4
,, ,, sulphurous acid	— ..	47 ..	44
,, ,, baryta	— ..	3 ..	3
,, ,, other chemical clarifying agents	— ..	1 ..	1
Triple-effect evaporators	— ..	13 ..	12
Quadruple-effect ,,	— ..	55 ..	32
Quintuple-effect ,,	— ..	16 ..	18
Factories returning their green syrups to the carbonatators	— ..	12 ..	12
Factories returning their green syrups to the pans	— ..	56 ..	53
Factories using open crystallizers	— ..	54 ..	53
,, ,, closed ,,	— ..	9 ..	13
,, ,, the Steffen process	— ..	2 ..	2

¹ Published by the *Bulletin de statistique et de législation comparée*; and reproduced by the *Journal des Fabricants de Sucre de France*, 1921, No. 13 (April 1st).

² The sugar in the molasses is included in this return.

Production of 95-97 per cent. Alcohol for Motor Fuel.

A British-made Plant.

In the July issue of this *Journal*¹ a description was given of a plant constructed by a French firm for the distillation and rectification of alcohol for the production of "Natilite" at Merebank, South Africa. Attention may, however, be drawn to the fact that a British firm, Messrs. BLAIR, CAMPBELL & McLEAN, Ltd., of Govan, Glasgow, has also designed and erected a plant for the manufacture of "Natilite" in South Africa. This apparatus has given great satisfaction to those concerned, and yields a practically pure neutral spirit of 95-97 per cent. strength continuously in one operation.

It is of the improved triple column type, shown in the illustration, and consists of a number of circular sections containing the stripping and concentrating plates. The steam entering at the lowest section of the separating and boiling columns passes through a number of holes in the plates, covered by inverted cups or "bells" which are arranged so that the vapour is distributed evenly through the wash, which, entering at the top of the lower portion of the separating column, descends through overflow or "dip" pipes on each plate and is collected on each concentrating tray, and then follows the same course in the boiling column. These overflows are arranged to ensure the correct mixing and flow of the vapour and liquid, and are sealed at the lower ends by the liquid in order to prevent any vapours rising through the column without passing through the wash.

The arrangement of the distributing bells and the concentrating plates has been designed to ensure obtaining the maximum transmission of heat by the intimate contact of the vapour with the liquid, and the indirect heating through the plates, an efficient distribution over the plates and a rapid circulation of the liquid through the apparatus being also effected.

Special attention has been paid to the accessibility of the still for the purpose of cleaning so that the distributing bells and overflow pipes can be quickly inspected and cleaned through handholes arranged on the side of the column.

A preheater is supplied, arranged so that the cold incoming liquor is raised in temperature by the exhausted hot wash leaving the boiling column, and a considerable economy in the steam consumption is thus realized. A steam regulator operating on a float principle is also provided, and this, together with a liquor controlling device, ensures a steady and constant supply of steam and liquor, thus rendering the plant practically automatic in operation and calling for a minimum of attention and labour.

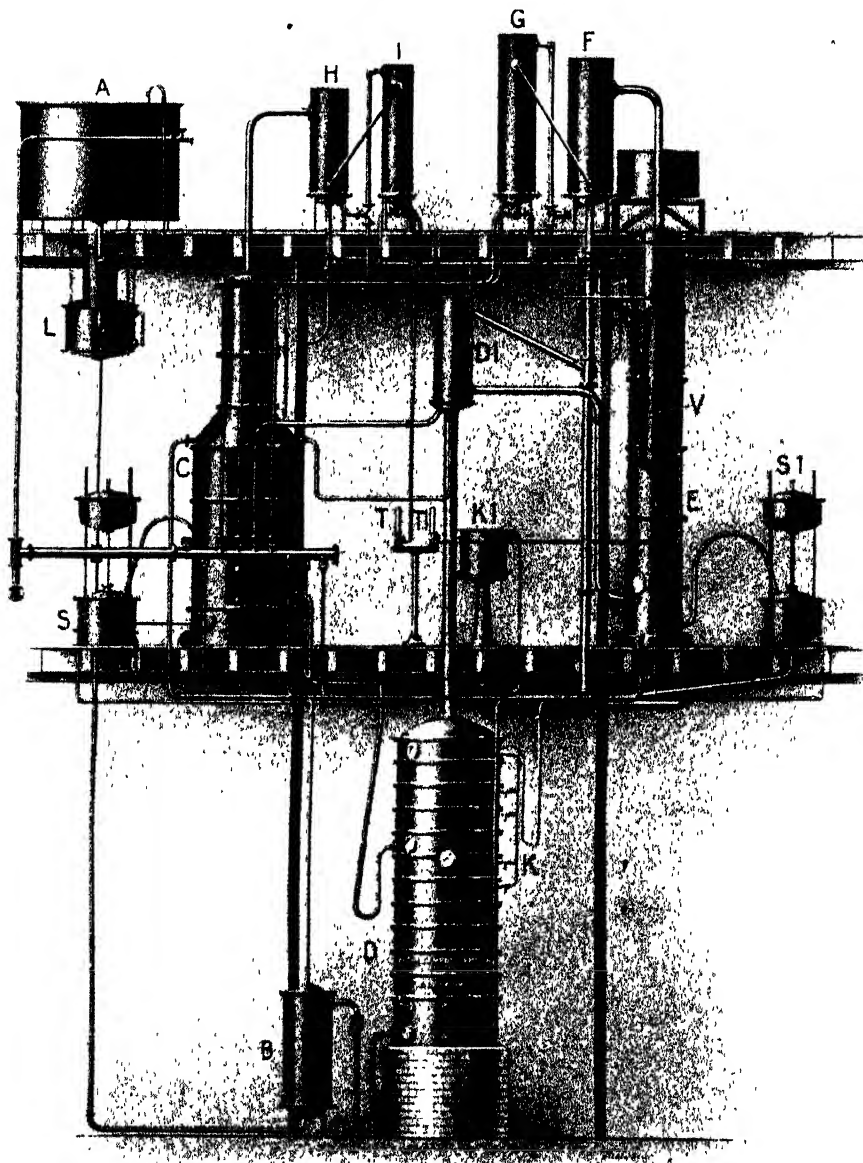
In working the still, the fermented and attenuated wash is pumped to the supply tank *A*. From here the wash runs by gravity into the float regulating tank *L* which automatically maintains a constant head or pressure of liquor on the feed, no matter what the amount of liquor in supply tank may be. This prevents excessive fluctuations of flow in the columns and allows the steam regulation to be made automatically to suit the distillation.

From *L*, the wash runs to the separating column *C*, passing through the wash preheater *B* on the way, where it absorbs a maximum amount of heat from the outgoing spent wash. The preheater *B* is so constructed that the outgoing hot liquor passes *around* the tubes of the preheater and the inflowing wash passes *through* the straight tubes.

On entering the separating column *C*, the wash at the preheated temperature gives up its aldehydes and ethers, which pass to the upper portion, the wash con-

¹ *I.S.J.*, 1921, 386.

taining spirit flowing down over the plates in the lower half of the column *C*. Steam is admitted into this lower column by means of the automatic regulator *S*, which gives just the amount necessary to remove the light boiling products but very little spirit.



IMPROVED TRIPLE COLUMN CONTINUOUS STILL.
(For the Production of 95-97 per cent. Alcohol for Motor Fuel.)

Production of 95-97 per cent. Alcohol for Motor Fuel.

The aldehydes and ethers, along with a very small amount of spirit always found in their presence, pass up through the rectifying plates in *C* into the tubular rectifier *H*, where they are cooled to strengthen them and remove spirit and water. Thence they go into the tubular condenser *I*, where they are condensed by water circulation and are drawn off by pipes through the regulating tester *T* to the storage tank.

After the preliminary heating and distillation in the separating column *C*, the wash containing spirit, oils, etc., passes into the boiling column *D* and flows down over the extracting plates. Steam is admitted into the bottom of *D* and the exact amount necessary to completely exhaust the wash is regulated by the steam regulator *S.I.* automatically. This regulation is dependent on the rectifying column *E*, where the spirit is purified so that exact automatic regulation of steam is always maintained no matter what the variation of the concentration of wash (within limits of course). It has been found from practice that the wash can vary in strength from 0.6 per cent. to 10 per cent. without altering the "set" of the regulators *S* and *S.I.*, but smaller limits are preferable for steady running.

The wash passing through the lower half of *D*, as stated, is totally exhausted of its spirit content, while the vapours pass up into the lower portion of the column where the oils and water vapour are partially removed by fractionation. The oils are drawn off continually at *K* through cocks and pass into the oils condenser *K.I.*, where they are cooled and drawn off through the oils testers or observation glasses and run to the oils receiving or washing vat. As they carry some spirit and water with them, they are allowed to settle and the watery layer containing spirit is returned to the wash tank for re-distillation. (The oils washing and separating vat is not shown on the illustration.)

The spirit vapours, carrying some oils and water with them, pass up from the boiling column *D* into the boiling column rectifier *D.I.*, where by water circulation they are cooled partially and thus deposit some water and oils, leaving the vapours enriched in spirit to pass to rectifying column *E*. The water and oils deposited in *D.I.* are returned through a sealed pipe by gravity to the separating column *C* for passing through the system again.

In the rectifying column *E* the spirit is rectified and concentrated by passing through the plates and concentrating bells. It is washed pure by having to pass through returning pure spirit which is condensed in *F* and *G*. The spirit and impurities which collect on the plates in *E* return to boiling column *D* to be re-distilled. The purified vapours are rectified and brought finally up to the desired strength in *F* and *G*, a small portion being returned to column *E* for washing purposes. The balance condensing in *G* is passed to cooler *V* and then drawn off through the regulating tester *T.I.* to storage.

The strength and regular operation is controlled by the tester *T.I.* where the spirit flows in view all the time, and is tested as required by hydrometers, and the thermometers on the columns indicate to the operator the rate at which it is necessary to draw the finished spirit from *T* and *T.I.*

All the regulation which it is necessary for the operator to do is to draw off spirit in accordance with temperature indicated in the rectifying column; to turn on steam and to set the flow of wash and cooling waters when starting up. During working, the operator's duties are to test the spirit and watch the temperature. In ordinary practice the still runs from day to day without requiring alteration to the rate of discharge, so that periodical tests of strength are all that is necessary.

Many operating tests have been made on these stills, and it has been found that the average recovery of alcohol runs as high as 98½ per cent.

Messrs. BLAIR, CAMPBELL & McLEAN, Ltd., also supply a very efficient type of ether apparatus for the production of the "Natlite" mixture.

Water Concentration, a Neglected Factor in Polariscopic Methods of Sugar Analysis.

By C. A. BROWNE.

The assertion of Dr. JACKSON and Miss GILLIS in their last paper¹ that the replacement of sugar by water, when the volume concentration of the salt remains unchanged, is not a dilution and that the effect to which the writer has called attention is wholly improbable, can very easily be put to an experimental test by increasing the amount of salt until the variations in reading become more noticeable. This experiment has been performed repeatedly by the writer and always with the result of proving that such an effect exists.² A single illustration is given in Table I.

Table I.

(Showing influence of water concentration upon the polarizing power of sucrose in presence of sodium chloride.)

A. GRMS. SUCROSE PER 100 C.C.	B. GRMS. SODIUM CHLORIDE PER 100 C.C.	C. GRMS. WATER PER 100 C.C.	D. PER CENT. SALT IN SOLVENT. 100 B B + C	TUBE LENGTH, MM.	POLARI- ZATION.
26 ..	20 ..	76.17	20.80 ..	200 ..	94.75
13 ..	20 ..	84.65	19.13 ..	400 ..	95.10

Decreasing the amount of sucrose increases the water content of the solvent and causes the loss in polarization to diminish from 5.25 to 4.9, which is proportional to the change in salt concentration from 20.80 to 19.13.

The deviations noted can easily be verified by anyone who has a saccharimeter and the necessary tubes and flasks. The variations are too great to be explained by any differences in the reading of saccharimeter scales or quartz plates. It is hoped that Dr. JACKSON and Miss GILLIS will repeat the experiment in Table I with sucrose and other sugars before committing themselves irrevocably to the decision that because the volume concentration of a salt or acid is constant, its effect upon the polarizing power of a dissolved sugar is also necessarily constant.

Dr. JACKSON and Miss GILLIS show on theoretical grounds that, even assuming there be such an effect as that claimed by the writer, the calculated depression is negligible in so far as the value of the positive constituent of the Clerget divisor is concerned. The calculated change in the positive constituent of Method IV of the Bureau of Standards Scientific Paper 375,³ according to the process of calculation illustrated in Table IV, is from 99.38, the Jackson-Gillis value for 26 grms. of sucrose in 100 c.c., to 99.48 for 0.26 grms. of sucrose in 100 c.c. The writer is perfectly willing to accept these theoretical values in place of his experimental results previously reported. This, however, does not affect the much greater error in the negative constituent of the Clerget divisors, and it does not affect in

¹ *I.S.J.*, 1921, 445.

² All the experimental data upon the effects of water concentration on the polarizing power of sugars in mixed solvents will be given in a subsequent paper which is to deal with this whole question more exhaustively.

³ *I.S.J.*, 1920, 642.

Water Concentration and Polariscopic Methods of Sugar Analysis.

the slightest the general principle of the writer's main criticism, which, as stated explicitly in his first communication, is that the Clerget divisor should be based upon the total carbohydrate or water concentration of the solution used for analysis and not upon the sucrose content or upon the $P - P'$ values which are the basis of the tables in Scientific Paper 375 of the Bureau of Standards.

It will be interesting to note the influence of water concentration on polarization of invert sugar and invert sugar plus dextrose in presence of ammonium chloride, the results being indicated in Table II where the various readings were made in presence of 3.392 grms. of NH_4Cl in 100 c.c., the process of inversion with hydrochloric acid and neutralization with ammonium hydroxide being the same as that described by Dr. JACKSON and Miss GILLIS under their Method II.¹

Table II.

(Showing influence of water concentration on polarization of invert sugar and invert sugar plus dextrose in presence of ammonium chloride.)

	GRMS. SUCROSE INVERTED.	GRMS. DEXTROSE TAKEN.	TUBE LENGTH, MM.	POLARISCOPE READING AT 20°C.
a	26	..	200	.. — 35.05
b	—	.. 26	200	.. + 79.26
			Sum	+ 44.20
c	13	..	400	.. — 33.95
d	—	.. 13	400	.. + 78.50
			Sum	+ 44.55
e	13	.. 13	400	.. + 44.15

The mixture of sugars in experiment *e* is dissolved in a solution which has approximately the same relation of water to ammonium chloride as have the solutions in experiments *a* and *b*. The polarizing power of the mixture of sugars is therefore represented by the sum of the readings in experiments *a* and *b* and not by the sum of the readings in experiments *c* and *d*, where, although the amount of each sugar dissolved in 100 c.c. is the same, the relation of water to ammonium chloride is different.

It is thus demonstrated that the Clerget divisors in the tables of Dr. JACKSON and Miss GILLIS are not dependent upon the concentration of sucrose or upon the $P - P'$ values, as they assume, but upon the water concentration of the solution used for the analysis. The extent of the error which neglect of this principle involves may exceed considerably the 0.10 limit, which Dr. JACKSON and Miss GILLIS regard as the extreme maximum error of their method.

A good test for the claim of complete applicability which Dr. JACKSON and Miss GILLIS make for their modified Clerget method is the analysis of the mixture containing 50 per cent. sucrose and 50 per cent. dextrose. We will make the test first upon a full normal weight of mixture containing 13 grms. of refined sugar (polarizing 99.85) and 13 grms. of anhydrous dextrose, the process of inversion and neutralization with ammonium hydroxide being that of the Jackson-Gillis Method No. II.

Direct polarization P , 26 grms. mixture, 200 mm. tube, 20°C. + 89.26
Invert ,, P' , 26 ,, ,, 200 mm. ,, 20°C. + 22.15

Difference $P - P' + 67.10$

The Clerget divisor under the same conditions is found to be 134.4 for 26 grms. of pure sucrose and 133.3 for 13 grms. of pure sucrose. The solution containing

¹ I.S.J., 1920, 840.

the 26 grms. of mixture has approximately the same water content as that containing 26 grms. of sucrose; and we should therefore employ the divisor 134.4, which gives 49.93 per cent. sucrose (the theoretical value). The factor 133.3, on the other hand, gives 50.34 per cent. sucrose, which is about 0.4 too high.

The question now arises as to the extent of the error when fractions of the normal weight of 26 grms. are taken for analysis. It is evident that if 13 grms. of dextrose displace a certain weight of water when a full normal weight of mixture is taken for inversion, only 6.5 grms. of dextrose effect the displacement with a half normal weight and 3.25 grms. with a quarter normal weight. The errors due to the displacement of water by other sugars than sucrose are therefore halved with each halving of the charge taken for analysis. The error of 0.4 per cent. in the determination of sucrose in the 50 per cent. sucrose + 50 per cent. dextrose mixture when a full normal weight of 26 grms. is taken, becomes an error of 0.2 per cent., with a half normal weight of 13 grms., and an error of 0.1 per cent. with a quarter normal weight of 6.5 grms. of mixed sugars.

In order to verify this calculation we will now make a second test upon a half-normal weight of the same 50 per cent. mixture of sugars, the process of inversion and neutralization with ammonium hydroxide being again that of the Jackson-Gillis Method No. 11.

Direct Polarization, P , 13 grms. mixture, 400 mm. tube	20°C. + 88.95
Invert ,, P' , 13 ,, ,, 400 ,, ,, 20°C.	<u>22.35</u>
Difference $P - P' + 66.60$	

Since the water concentration of the solution is for 13 grms. of mixed sugars, the Clerget divisor established for 13 grms. of pure sucrose should be used; and this, according to the Jackson-Gillis Table 17, is 133.34, which divided into 66.60 \times 100 gives 49.95—very close to the theoretical value of 49.93. The Clerget divisor for a $P - P'$ value of 66.6, according to the Jackson-Gillis table, is 132.9, which divided into 66.6 \times 100 gives 50.11 or an increase of 0.18 above the actual percentage present. The error thus found agrees with the value of 0.2 per cent., which was calculated for a half-normal weight from the experimental results found for a whole normal weight. The same proportionate error will of course be found in any product of which sucrose forms half the total sugars.

The claim of complete applicability which Dr. JACKSON and Miss GILLIS make for their modified Clerget method is thus disproved. The test analyses, which they present to demonstrate their claim, are made upon mixtures in which the errors due to water displacement are less pronounced than in the 50 per cent. test mixture of the present paper. This is also true of the writer's previously published test analyses, which Dr. JACKSON and Miss GILLIS quote as an argument against the influence of water concentration upon the results of the Clerget method.

Water concentration, therefore, is a neglected factor of great importance in optical sugar analysis. In the early days of the science, chemists seem unconsciously to have recognized this, and adjusted their sugar solutions to a uniform specific gravity. Subsequently, however, the practice of volume concentration gained the upper hand and in some respects this departure from percentage concentration was unfortunate. Water, being optically inactive, neutral and completely volatile, has been dismissed from account as an unessential and unimportant factor, whereas, as a matter of fact, it is concentration of water and not concentration of sugar that causes variations in specific rotation. If sugar solutions could always be polarized at a constant density, the selection of constants for Clerget divisors, specific rotations, etc., would be greatly simplified. While it

Water Concentration and Polariscopic Methods of Sugar Analysis.

is not always practicable to make up sugar solutions to one density, chemists can at least correct for changes in water concentration. Water can be determined approximately with a refractometer or hydrometer and this will probably be found to be sufficiently accurate for most purposes of analysis. The writer is at present graduating some "Clerget spindles" for this purpose, the depth to which the spindle sinks indicating the Clerget divisor to be used in the calculation. The spindle can of course be graduated to suit the requirements of any particular method of analysis.

The writer realizes that the criticisms contained in this paper are directed as much against some of his own published methods as against the methods of others. This, however, causes him no concern. Methods of chemical analysis are ephemeral. They should not be too rigidly formulated or standardized, for they must continually be revised in the light of new knowledge. Methods of analysis, after all, are only a means to an end. The underlying principle of the method and the end which it is designed to serve, are the things of permanent value.

Some Notes on Cuba.

(By our Havana Correspondent.)

With the recent termination of the manufacturing season in the Cuban sugar industry, the general order given to the managers of the factories can be summed up in the words, "Shut down and stop all work until further orders." This is the condition of affairs at the sugar factories and plantations all over the island: no work is being done and everything is at a standstill. The immediate consequence is that a great deal of misery and starvation has developed amongst the working classes, and the whole country reveals at the present moment a sad and neglected appearance.

The reason for this is of course the big fall in sugar prices. In anticipation of the crop just ended and when sugar prices were high and looked like staying at a much higher figure than rules to-day, banks and merchants loaned moneys on sugar and cane, basing their loans on those high prices; and to-day, with sugar down to a low level of prices, large sums of money have been lost through depreciation, and numerous factories and plantations are involved.

With the termination of the manufacturing season, the banks ceased all loans and are now taking stock of the situation. In order to protect themselves as far as they can, they are investigating the profit-earning powers of the mills with a view to financing only those mills that can show the necessary profits; and those mills that cannot make sugar and put it on the market for a certain sum will receive no financial help whatever; the owners will have to look elsewhere for such aid.

The writer has heard it said, and he thinks it may be taken as correct, that some banking institutions have fixed the price at which the factories must market their sugar (that is, place the sugar in the warehouses at the seaports,) at not more than 2 cents per lb. Otherwise financial assistance will be refused. It is probable that all the banks will fall into line with this policy.

Owing to the fact that the mills owe the banks large sums, a considerable number of them have been placed under the administration of the banks until such time as their owners are able to regain control or a change of ownership is effected. Meantime the banks are taking stock, and until they have decided

which mills are to carry on and to what extent they will assist them, no work can be done on them. It is, however, generally supposed that these questions will be decided in New York within the next few weeks, and that repairs preparatory to the coming crop will be started early in September.

On this assumption, one can look for an improvement in the whole situation by the end of September or beginning of October, as by then large numbers of workmen should be employed and earning wages.

It is a difficult task estimating with any degree of accuracy the extent of the unpaid machinery bills belonging to Cuba. One newspaper, usually well informed, placed the sum total at \$400,000,000. This appears to be a very high sum, but it must be remembered it extends over several years, and also includes besides sugar machinery, locomotives and cane cars.

Undoubtedly manufacturers have risked enormously, and they will now have to take the heavy losses. One firm, to our knowledge, is at present shipping back to the United States, machinery for a complete sugar factory. This machinery was delivered to Cuba about a year ago, but owing to the Moratorium and shortage of money, it was not erected. There are quantities of machinery, locomotives, and cane cars all over the country, which still belong to the manufacturers, and on which heavy losses will have to be taken, as to ship them back to the United States, save in special circumstances, looks like adding loss to loss.

In many cases it will be difficult to get owners to make payments on much of the machinery and rolling stock, as to-day they can buy at 40 per cent. under the prices ruling when they placed originally their orders. And as, in many instances, no payment has yet been made, it will be difficult, and in most cases impossible, to collect on prices fixed at date of order.

Such is the sugar situation as it stands to-day in Cuba, but, as mentioned above, it is on the point of changing for the better, and the next few weeks ought to see the beginning of brighter days.

July 29th, 1921.

Examinations in Sugar Manufacture.

Attention was called last year¹ to the examinations in Sugar Manufacture, which are conducted annually by the City and Guilds of London Institute. During the war it was found necessary to suspend these examinations, but they have now been resumed, and in April last a fair number of candidates from different parts presented themselves.

The certificate granted to successful candidates is recognised as a useful qualification for the young sugar chemist and engineer at home and abroad. There has always been keen competition for the medals² awarded to the candidate obtaining the highest number of marks (provided that these are not teachers).

Attention is directed to the fact that the Institute's examinations are held in India, in many of the Overseas Dominions and in some Colonies. Arrangements could probably be made through the respective Directors of Education for the Dominion or Colony for the examination to be held at centres in South Africa, Australia, the West Indies, Mauritius, India, and Hong-Kong.

In the past the examinations have been held in two grades, known as Grade I and the Final Examination. But by an agreement concluded between the Board of Education and the Institute, only the Final Examination will be held in future

¹ *I.S.J.*, 1920, 439.

² Bronze in Grade I, and Silver in the Final.

Examinations in Sugar Manufacture.

at centres in England and Wales, it being expected that examinations required of a lower standard will be conducted by the authorities of technical schools. In Scotland, Ireland and Overseas, however, the examinations will continue to be held in both grades if a sufficient number of candidates is forthcoming. Candidates in the United Kingdom should in general make arrangements for their accommodation for examination through the authorities of the technical school in the town in which they reside, and those desirous of entering at centres Overseas should communicate with the local Director of Education. If any candidates desirous of entering are unable to arrange for their accommodation for examination in this way, they should communicate before the end of the year with the Superintendent, Department of Technology, City and Guilds of London Institute, Exhibition Road, South Kensington, London, S.W. 7, who will endeavour to suggest the name of the nearest centre at which they may be able to obtain accommodation.

The fee for the examination in Grade I is 3s., and for the Final examination 6s. Candidates at centres outside the United Kingdom are required to pay in addition a fee of 1s. each. The date fixed for the examination is Tuesday, May 2nd, 1922. All entries should be in the hands of Local Secretaries in the United Kingdom by March 15th; but entries from candidates Overseas should be made before the end of the year. Requisition forms for question papers are forwarded to Secretaries of Examination centres by the Superintendent of the Department of Technology of the City and Guilds of London Institute at the address stated.

SYLLABUS.¹

In Grade I the examination will include questions founded on such subjects as the following :—

1. Sugar : its occurrence in plants.
2. Extraction of the juice. Milling. Diffusion.
3. Clarification of the juice. Defecation and carbonatation processes. Use of sulphurous and phosphoric acids.
4. Concentration of the juice. Extrainment in evaporation : its detection and prevention. Scale formation.
5. Crystallization of the sugar. Pan manipulation. Methods of sugar boiling in the cane and beet sugar industries. Crystallization-in-motion.
5. Curing the massecuite. Washing. Packing and warehousing. Molasses and its utilization.
7. Refining raw sugar. Washing, melting, defecation, and filtering. Animal charcoal, its application and revivification. Boiling in the refinery, and the production of granulated, cubes, "pieces," etc.
8. Principles underlying the construction and use of the machinery and apparatus in sugar factories and refineries.
9. Sugar analysis. Determination of sucrose, reducing sugars, dry substance, and ash in the several products of the factory and refinery.

In the Final Examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of :—

1. Chemistry of sucrose, dextrose, levulose, and raffinose ; their nature and behaviour under the influence of heat, acids, alkalis, and ferments.
2. Constituents of the sugar cane and sugar beet, and their behaviour during the manufacture of sugar from these plants.
3. Recent development in juice extraction, clarification, evaporation, boiling, and curing. Sugar deterioration. Molasses exhaustion.
4. Plantation white sugar manufacture, advantages and disadvantages of the different processes.
5. Chemical control in the sugar factory and refinery. Sugar-house calculations. Analytical examination of the materials used in the manufacture of sugar.

Works of Reference.—"Handbook for Cane Sugar Manufacturers and their Chemists," Guildford L. Spencer, 5th edition (Chapman & Hall, Ltd., London) ; "Cane Sugar," Noël Deerr, 1921 edition (Norman Rodger, London) ; "Cane Sugar and its

¹ Recently revised.

Manufacture," H. C. Prinsen Geerligs (Norman Rodger, London); "Practical White Sugar Manufacture," H. C. Prinsen Geerligs (Norman Rodger, London); "Plantation White Sugar Manufacture," W. H. Th. Harloff and H. Schmidt (Norman Rodger); "Chemical Control in Cane in Cane Sugar Factories," H. C. Prinsen Geerligs (Norman Rodger, London); "Betterave et Suererie de Betteraves," Émile Saillard (J. B. Baillière et Fils, Paris); "Sugar: A Handbook for Planters and Refiners," Newland Bros. (E. & F. N. Spon, Ltd., London); "Beet Sugar Manufacture and Refining," Lewis S. Ware (Chapman & Hall, Ltd., London); "Beet Sugar Manufacture," H. Claassen (Chapman & Hall, Ltd., London); "Handbook of Sugar Analysis," C. A. Browne (Chapman & Hall, Ltd., London).

Periodicals.—"International Sugar Journal," London; "Journal of the Society of Chemical Industry," London; "Reports of the Progress of Applied Chemistry" (Section on cane and beet sugar manufacture, and sugar refining, published by the Society of Chemical Industry, London).

In the Final Examination held in April last the following paper was set:—

1. Give an account of the clarification of cane juice by means of *either* the carbonation or the sulphitation process, devoting special attention to the behaviour of the reducing sugars throughout the several operations. 2. State the average percentage composition of: raw cane juice; final cane molasses; final beet molasses; "pieces"; new animal charcoal; spent animal charcoal; filter press cake (as obtained in the defecation process). 3. Outline the scheme you would adopt for the determination of the possible sources of loss of sucrose in the manufacture of raw sugar from the cane. 4. Describe the construction and discuss the practical operation of any form of filter used in sugar manufacture or refining. Use sketches where necessary. 5. Describe in detail the analytical method which in your opinion is capable of yielding the most accurate result in the determination of sucrose in cane molasses. Mention possible sources of error, and state the measures you would adopt for the purpose of overcoming these. 6. What is (a) animal charcoal, and (b) decolorizing carbon? Give a concise account of the practical application of animal charcoal in the refinery. Explain the possible advantages that decolorizing carbon may possess as a substitute for animal charcoal in the refining of raw sugar. 7. Give a brief account of the colouring matters present in raw cane juice as it comes from the mill. Describe the behaviour of each during clarification by (a) the ordinary defecation process, and (b) the carbonation process. 8. Discuss the diffusion process as a means of extracting juice from the cane, and state clearly the several reasons why this method has not been given general preference over milling. 9. Write an account of the question of the deterioration of raw sugar during storage, indicating clearly: (a) its causes, and (b) the means that have been suggested for its prevention. What do you understand by the "factor of safety" of a sugar?

In the last issue to hand of the organ of the British Empire Producers' Association,¹ we are optimistically informed that: "Very soon the Empire will be sending to the United Kingdom substantial quantities of sugar which the consumer may purchase without the intervening process of refining. Of the total amount of sugar consumed in this country, 80-90 per cent. could probably be suitably met by direct consumption sugars if it were possible for that amount to be produced. The first thing to overcome on the part of the producer is the prejudice in the mind of the consumer against sugars direct from the plantation. . . . The next is the removal of the prejudice against coloured sugars which for very many ordinary purposes are preferable, as being of a higher sweetening power than sugar which has been rendered white. . . . And there are those who go so far as to predict that if the producing industry rest but true to itself, there will be concentrated on the markets of the British Empire a supply of plantation sugars for almost every conceivable purpose which may render the business of refining, as an independent industry, uneconomic."

¹ *Production and Export*, 1921, No. 60, August.

American Commerce Reports.¹

NEED FOR NEW SUGAR MILL EQUIPMENT IN JAVA.

Opportunity for the renewal of plant is afforded in the sugar mills of Java, many of which are either out of date or in need of repair. Investigation has also shown that in the case of one of the finest mills in the island a very high percentage of sugar content is left in the cane. This is due to insufficient fuel supply and to waste of power, which should be considered in connection with the installation of further machinery, such as extra rolls and bagasse burners, to bring these mills up to approximately 100 per cent. efficiency. While some of the 187 sugar mills operating in Java are small, others have two and four sets of rolls. A conservative estimate would place the average value of machinery for these mills on a pre-war basis, at approximately \$750,000, representing about \$140,000,000 worth of sugar mill machinery in Java. If figured on the basis of present-day prices, this amount would probably be doubled, and to bring these mills up to efficiency, without replacement, would require an additional investment of from 10 to 20 per cent. Because of the economy exercised during the war in repairs and extension of plants, it is believed that at least 70 of the Java mills will have to be replaced within the next few years.—[Trade Commissioner's Report, June 1921.]

LARGE ELECTRIFIED SUGAR MILL IN CENTRAL AMERICA.

It has been decided to electrify the new sugar mill of the Sula Sugar Co. at La Lima, Honduras, and plans have been drafted which will make it the largest electrified sugar mill in Central America. Power will be developed by a 1000-kilowatt turbo-generator set with an auxiliary set of 200 kilowatts for lighting and general purposes. All the electrical equipment will be furnished by an American company, and installation will be made by the same American company that is constructing the mill. The fuel to be used for running this system will be the waste bagasse, the supply of which is expected to be sufficient. Construction of the new mill is going forward rapidly. The boilers have been set in place and smokestacks and water towers erected. Most of the heavier machinery is also installed, and the machine shop is nearly completed. The first cane will be crushed in October.—[Consular Report, April, 1921.]

THE 1920-21 NATAL SUGAR SEASON.

With the close of the year the crushing season for sugar cane in Natal and Zululand virtually came to an end. A few factories are finishing their crops, but the large majority have ceased operation until the end of May or the middle of June. For some time to come the refineries will go on refining the sugar that they now have on hand. As no more cane will be crushed until June the country will have an opportunity to use up the large existing stocks. There is some talk of having to export a quantity for which it is assumed there will be no demand in South Africa.

The season opened inauspiciously with a severe drought, in fact, one of the worst ever known in Natal, the effect of which was to reduce the yield by approximately 50,000 tons. The total output is not likely to exceed 150,000 tons of manufactured sugar, in contrast with 185,000 tons produced last season. Just as the first part of the season was remarkable for a severe drought, so the latter portion was conspicuous for an exceptionally wet period. On the south coast, where the effects were the worst, the cane never properly recovered. At Illovo 12 to 13 tons of cane were required to make a ton of sugar at the end of the season.

Since the beginning of the war the quantity of sugar manufactured annually in Natal has shown a tendency to advance except in the case of 1917-18 and the present year. In the season of 1916-17 the output was 114,580 tons, which dropped to 107,060 tons the next year; in 1918-19 it rose to 155,000 tons; and in 1919-20 to 185,000 tons, but declined in 1920-21, as already said, to 140,000 tons.

¹ Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

American Commerce Reports.

A rough estimate—that is, figuring 11 tons of cane to 1 ton of sugar—would give a total of 1,540,000 tons of cane handled for 140,000 tons of sugar manufactured. The gross value of the crop this year, at an average price of £50 for a ton of sugar, would be £7,000,000 (\$34,066,000 at normal exchange).

One of the remarkable features in the development of the sugar industry in this section in the last five or six years is that, whereas formerly the sugar cane was planted by men with large holdings, usually by a man owning a mill, it has now become the practice for small holders to plant cane and sell it to the mills.—[Consular Report, February, 1921.]

Correspondence.

BAGASSE CARBON.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—In your June and July editions you publish two letters from Mr JOHANN SAUER bearing on the use of bagasse char as a filtering medium, and I beg to thank you for your impartial comments on these letters.

Mr. SAUER said that I "boldly asserted" the invalidity of his patent. This is quite incorrect. I only said that Mr. Sauer's claim as far as bagasse char is concerned is void, leaving alone his other claims.

I believe that every expert who takes the trouble to compare the specification and claims of my U.S. Patent, No. 455,675, of July 7th, 1891, with Mr. Sauer's claims would agree with me on this point.

Permit me to state in the interest of the cane sugar industry the following:—

I have found that crude bagasse meal, which costs practically nothing to the manufacturer, will act in the mechanical filtration of cane juices about as well as bagasse char. By passing the bagasse coming from a 9 or 12-roller mill and crusher through a sufficiently large smooth sieve, of, say, 16 mesh, agitated by a crank shaft, a large amount of bagasse meal can be gathered. On adding a certain quantity of this meal to the defecated juice before settling, and then running the whole through filter-presses, a clear juice free from all suspended matter, lime, and gum will be obtained. What this means every cane sugar man knows. Further, by treating the thick-juice or syrup coming from the multiple effect with some lime, sulphur fumes, or phosphoric acid, adding some more bagasse meal, and then filtering, a fair plantation granulated can be boiled from the juice.

Yours faithfully,

MORIZ WEINRICH.

Lefever Falls, Rosendale, N Y.,

August 3rd, 1921.

In the process of "cracking" petroleum oil for the purpose of obtaining fractions of lower boiling point, Mr. CARLETON ELLIS has observed that the olefines formed may be passed through an absorbing tower containing sulphuric acid, and the resulting propyl sulphuric acid treated with water to give propyl alcohol. This is now being done,¹ and a product has been put on the market² as "Petrohol" containing about 92 per cent. of propyl alcohol and 8 per cent. of water. It may be used as a non-freezing motor fuel, or as a solvent for use in different chemical industries.

A concern under the title of the Victoria Nyanza Sugar Co., Ltd., is being organized with an authorized capital of £400,000. It is proposed to acquire from G. R. MAYERS 6716 acres of land situated near Victoria Nyanza, and the machinery of the Pangani Sugar Factory (from the Custodian of Enemy Property, Dar-es-Salaam). Additional machinery is to be installed to increase the capacity of the factory to about 600 tons of cane per day, and a distillery is to be added. Situated on the Uganda Railway, the property is said to be excellently adapted for sugar production, in respect of soil, rainfall, and labour.

¹ *Petroleum Times*, January 29th, 1921.

² By the Melco Chemical Co., of Bayonne, N.Y.

Publications Received.

Alcohol Motor Spirit and the Possibilities of its Production in British Guiana. A report to Messrs. Booker Bros., McConnell & Co., Ltd., by E. C. Freeland, B.Sc., and W. G. Harry. ("The Argosy" Co., Ltd., Demerara.) 1921.

This useful report reviews the present position of the question under the headings of: general characteristics of alcohol as motor fuel; relation of the properties of alcohol to its behaviour as a motor fuel; comparison of petrol and alcohol as a motor fuel; advantages and disadvantages of alcohol as compared with petrol as a motor fuel; and alcohol mixtures as motor fuel. The results are stated of local trials with two alcohol mixtures, viz., (1) 100 gallons of 94-95 per cent. alcohol, 8 gallons of petrol, and $\frac{1}{2}$ gallon of pyridine; and (2) an alcohol-ether mixture made up "on the Hawaiian formula," that is, alcohol 55.55 per cent., ether 42.78, kerosene 1.11, and pyridine 0.56; these fuels being compared with Trinidad petrol. On most points the trials were satisfactory, and in the case of the alcohol-ether mixture there was no difficulty in starting the engine from cold; the mileage was probably 10-15 per cent. greater than with petrol; and the flexibility of the motor was better, the acceleration from 10 to 20 miles per hour being very rapid. In regard to the possibilities of alcohol fuel in British Guiana, it is remarked that the present high price of petrol is no doubt preventing a number of estates from using agricultural machinery, pumping engines, etc. The Colony is capable of producing 1,900,000 gallons of alcohol motor fuel, or 1,360,000 gallons in excess of local requirements. "Besides the cost of manufacture, and that of packages, freight, etc., the legislative attitude of the British Government will be one of the chief factors in determining whether or not the complete motor spirit can be exported at a profit to the manufacturers."

Practical Biological Chemistry. By Gabriel Bertrand and Pierre Thomas. (G. Bell & Sons, Ltd., London.) 1921. Price: 10s. 6d.

This book, an English translation by Dr. H. A. COLWELL of Bertrand's "Guide pour les manipulations de chimie biologique," is designed to afford a comprehensive scheme of elementary work in biological chemistry over a very wide field. It is essentially broad and practical in character. Thus, it consists mainly of laboratory practice relating to subjects such as the glucose group; hydrolysable sugars; polysaccharides; glucosides; fatty acids; proteins and their products of hydrolysis; pigments; aromatic acids and enzymes. There is much interesting reading for the chemist and agriculturist in these sections, many of which contain information touching directly on the study of the elaboration of sugar by the cane and other plants. *Inter alia* a full account is given of Bertrand's volumetric method of determining reducing sugars, in which the cuprous oxide is dissolved in a solution of ferric sulphate, the ferrous sulphate formed being titrated with standard permanganate.¹ This is a rapid and reasonably precise process, which is largely used in France, and is prescribed for the use of Java sugar factory chemists in the last edition of Tervoorren's textbook.

L'Oeuvre de Ph. Bonâme à l'Île Maurice. Louis Baissac. (General Printing and Stationery Co., Ltd., Mauritius.) 1921.

Mr. BAISSAC gives in this pamphlet a list of the articles and reports published by the late respected Director of the Station Agronomique at Réduit, Mauritius, and further adds a very full index to the many subjects studied. He advises his colleagues, particularly the younger ones, to consult this index when they have need of information on the agriculture of Mauritius, believing that they will find in the Reports of the Station Agronomique the answer to many of the questions with which they may be encountered.

¹ See *J.S.J.*, 1919, 354.

A French-English Dictionary for Chemists. By Austin M. Patterson, Ph.D. (Chapman & Hall, Ltd., London.) 1921. Price: 18s. net.

This is a companion volume to Dr. Patterson's most useful "German-English Dictionary for Chemists"; and follows the plan then put into operation, which appears to have met with general favour. Thus, a general vocabulary is included with the technical words; the more important idioms are listed under the principal word occurring in the phrase; while irregular verb forms likely to appear in scientific literature are given where they are most needed, i.e., in the vocabulary under their own spellings, and not safely concealed under the parent verb, as is unfortunately the case in a number of dictionaries. There are also some useful preliminary notes on the nomenclature of compounds, which will be found useful by the student commencing the study of French chemical literature. As in the case of the German-English volume, we highly recommend this dictionary.

Report for 1918-20 of the Rothamsted Experimental Station, Harpenden (Lawes Agricultural Trust). 1921. Price: 2s. 6d. (foreign postage extra).

Important Facts for the Consideration of Sugar Cane Producers. By L. A. Becnel. (L. A. Becnel, P.O. Box 649, New Orleans, Louisiana, U.S.A.) 1921.

This is a discussion (illustrated by a coloured graphic chart and several examples) of the best policy to be pursued by the manufacturer of sugar and table molasses under varying marketing conditions.

Growing and Improving Sugar Beet Seed. V. Erhard - Frederiksen. (Erhard-Fredenksen Ltd., Lang., Denmark.) 1921.

An illustrated account is given of the work of the Danish firm of Erhard-Frederiksen, Ltd., in the production of sugar beet seed.

Denatured Alcohol at Home and Abroad. (Office of the Commissioner of Internal Revenue, Washington, D.C., U.S.A.)

This is a detailed report published in 1909 by the Commissioner of Internal Revenue and the Chief Chemist of the Bureau to the Secretary of the Treasury reviewing observations and work in Europe regarding denatured alcohol, its manufacture and uses.

Treatise explaining Adjustment of Fulton-Corliss Valve Gear. Bulletin 300, July, 1921. (Fulton Iron Works Co., St. Louis, Mo., U.S.A.).

This Bulletin explains the adjustment of the Fulton-Corliss Valve Gear with single and double eccentric, and covers the subject concisely, but thoroughly. It is illustrated with diagrams which help the reader to obtain a clear understanding of the text, and should prove a valuable addition to the library of every steam engineer. It is obtainable free on application.

Filtern und Pressen [Filters and Presses]. F. A. Bühler. Second Edition. (Verlag von Otto Spamer, Leipzig). 1921. Price: M. 11, plus 40 per cent.

A second edition of Bühler's useful work, an English translation of which with additions by the late J. J. EASTICK was published in 1914, has now appeared. In the main the book remains as before, though here and there the text has been brought up-to-date, and a few new illustrations have been inserted.

Publications Received.

Das Kalkbrennen [Lime Burning]. Berthold Block. With 88 illustrations. (Verlag von Otto Spamer, Leipzig). 1917. Price: M. 18, plus 40 per cent.

This book appears to us to be the most complete by far in any language on the subject of burning limestone for the production of lime and carbon dioxide. It discusses in a thorough manner from the practical and theoretical standpoints most phases of the subject. It will be found a valuable treatise by those interested.

Verdampfen und Verkoochen [Evaporation and Boiling]. W. Greiner. Second Edition. (Verlag von Otto Spamer, Leipzig). 1920. Price: M. 26, plus 40 per cent.

This is the second edition of a book, first published in 1912, which is highly regarded in Germany as a reliable general treatise on evaporation and boiling in the beet sugar factory. It is a particularly clear exposition of the subject by an author whose name is well known throughout the industry, not only in connection with a modification of the Pauly pre-evaporator, but also as a practitioner of life-long experience. Chapters that will especially repay perusal are those entitled: Ideal Evaporation; Real Evaporation; Heat transmission coefficients; Vacuum Pan Apparatus; and the Heat and Steam Requirements of the (beet) Sugar Factory.

Factors determining the Keeping Quality of Cane Sugar (with a Chart for Prediction). Nicholas and Lillian Kopeloff. Bulletin No. 170. (Agricultural Experiment Station, Louisiana State University, Baton Rouge, La., U.S.A.).

This Bulletin summarizes the recent work of these authors, the most important conclusions of which have been noticed in our pages.¹

Die Wirkungsweise der Rektifizier-und Destillier-Apparate [The Working of Rectifying and Distilling Apparatus]. E. Hausbrand. (Julius Springer, Berlin). 1921. Price: M. 64, plus 40 per cent.

This is a treatise on the theory underlying the construction and operation of apparatus for the distillation and rectification of two volatile liquids, as ethyl or methyl alcohol and water, acetone and water, ammonia and water, etc. It records data of importance to the engineer, whether engaged in the construction or the operation of apparatus of this kind, such as periodic rectification; processes taking place in the sections of the columns; necessary number of sections in columns for continuous distillation; and the alcohol content of liquid and steam in the sections of columns of various heights.

Sugar Supply of the United Kingdom. A Chart showing the Imports of Raw and Refined Sugar from all sources for ten years, 1911 to 1920 also Imports into the three Refining Centres of London, Liverpool and the Clyde; Quantity produced by Home Refiners; Quantity grown in England; Exports of British and Foreign Refined; and Total Annual Quantity of Refined Sugar available for Consumption. Compiled and Published by Messrs. Henry Tate & Sons, Ltd., Liverpool.

This excellent chart has been an annual production of TATE & SONS, Ltd., and those dealing in sugar statistics will find it a useful adjunct to their stock of information. We understand it is supplied free on application to Messrs. TATE & LYLE, Ltd., Mincing Lane, London, or Exchange Place, Liverpool.

¹ I.S.J., 1919, 465; 1920, 282, 523, 591.

Review of Current Technical Literature.¹

ANNUAL REPORT OF THE HAWAIIAN COMMERCIAL AND SUGAR CO. FOR 1920. *Hawaiian Commercial and Sugar Co., Puunene, Maui, T.H.*

Grinding was commenced on November 25th, 1919, and was finished on June 19th, 1920, the total area being 6547 acres (plant cane 2162 and ratoons 4395); the total cane ground, 378,285 tons; and the sugar produced, 57,120 tons. Average tons of cane per acre were 57.77; average tons of sugar per acre were 8.72 (9.740 plant and 8.230 ratoons); and average tons of cane per ton of sugar, 6.53. Plant cane juices showed average Brix, polarization, and purity values of 21.49-22.30, 19.26-19.96, and 87.4-90.2; and ratoon juices, 20.53-21.51, 18.57-19.03, and 88.0-90.5 respectively, the varieties planted being Lahaina, H 109, D 1136, H 20, and H 146. In the sugar factory two 12-roller mills were operated during about 80 per cent. of the season, and a 15-roller for the balance of the time, an average of 58.08 tons of cane per hour per mill being ground, and an average extraction of 98.92 per cent. being obtained. Regarding the losses, these were 1.08 in the bagasse, 0.45 in the press cake, 5.66 in the waste molasses, and 1.62 undetermined, a total of 8.80 per cent. A standard quadruple is now being installed to take the place of the old Lillie. Expenditures on improvements chiefly concern irrigation ditches, power plant, pipe lines, steam ploughs and tractors. The profit for the year was \$6,182,108, the capital of this concern being 400,000 shares, at \$25 par value, equal to \$10,000,000.

ASH CONTENT OF SUGARS, MOLASSES, AND CRUSHER JUICE IN DIFFERENT COUNTRIES.

R. C. Pitcairn. *Facts about Sugar, 1921, 12, No. 25, 491.*

A comparison of the percentage of ash (carbonated) in sugar factory products made in different countries is given, the average figures being as follows:—

	RAW SUGARS, 96-97° TEST.	WASTE MOLASSES.	CRUSHER JUICE.
Hawaii	0.43-0.89	8-12	0.173-0.311
Cuba	0.42-0.60	—	—
Porto Rico .. .	0.40-0.50	—	—
Java	0.23-0.47	7-10	—
Philippines (Sila) ..	0.23-0.35	6-7	0.258
Louisiana.. . . .	—	9-10	—

It is remarked that from the above comparison a striking difference is noticed in the ash per cent. of the raw sugars. The glucose in the crusher juice at the Hawaiian-Philippine Co's Silay Central is fairly constant around 1 per cent., and the sucrose in the mixed juice and syrup is at least 25 per cent. higher than like results in Hawaii. GERLIGER says that where glucose and salts are present in solution, the amount of sucrose crystallizing out increases in proportion as the liquid contains more glucose for the same amount of salts; and that a low ash content might occur with a high content of reducing sugars, when it would be easy to obtain a very low purity in the molasses. This, it is remarked, seems to be borne out in the manufacture of Philippine sugars.

DETERMINATION OF THE HYDROGEN ION CONCENTRATION, AND THE ADJUSTMENT OF THE REACTION (ACIDITY OR ALKALINITY) OF MEDIA. *Anon. Special Report Series, No. 35, Medical Research Committee.*

This is a very clear exposition of the present position of the determination of the hydrogen ion concentration, written more particularly from the point of view of the bacteriologist for the preparation of his culture media.² Experience has shown that titration tests with standard acid or alkali using litmus or phenolphthalein solution for indicating neutrality do not give the true reaction when carried out in culture media of different compositions. This is due for the most part to the fact that the end-point is not sharp,

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, I.S.J.)

² F. J. BATES and associates have drawn attention to the significance to candy makers of the reaction of refined sugars. See I.S.J., 1920, 654.

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there being a zone at which the addition of acid or alkali does not produce any striking change in the colour of the indicator. It is now recognized that this is due to the presence of compounds (as proteins, amino acids, phosphates, borates, etc.) which are capable of taking up hydrogen ions. The relation of a liquid is, therefore, better expressed by the concentration of hydrogen ions which it contains, and in accurate determinations of hydrogen ion concentrations the hydrogen electrode is used,¹ though in ordinary laboratory practice very accurate results may be obtained by a colorimetric procedure, using the special indicators having a sharp colour change recommended by LUBS and CLARKE,² and an apparatus termed a "comparator." Very full details are here given for carrying out hydrogen ion determinations by this method; and this is a pamphlet which should be of service to those interested in the subject of reaction determination.³

METHOD FOR THE DETERMINATION OF THE ACIDITY OF COLOURED SOLUTIONS (e.g., MOLASSES). J. L. Lizius. *The Analyst*, 1921, 46, No. 542, 194-195.

A small Buchner funnel (about 2 in. diam.) is connected with a flask and a filter-pump, and fitted with a filter-paper, which is moistened with several drops of phenolphthalein solution, the excess of which is removed by turning on the pump for a moment. To 10 c.c. of the coloured solution, N/10 alkali is added until it is just alkaline, the test for alkalinity being made by withdrawing a little of the solution by means of a fine capillary tube (a piece of melting-point tube), and touching the filter-paper. A pink colour being obtained, the whole of the molasses solution is run through the Buchner funnel, the filter-paper being of course left a pink colour. Now the contents of the Buchner flask are washed out into a beaker, and 0.05 c.c. of the N/10 acid added. One or two drops of phenolphthalein solution are run on to the filter-paper, and the coloured solution again poured through. If the filter-paper is not pink, the volume of N/10 alkali is the titration value. If, on the other hand, the paper is still pink, the addition of N/10 acid is continued, 0.05 c.c. at a time until the pink colour is no longer present. The titration value is the volume of N/10 alkali — (volume of N/10 acid — 0.05 c.c.). It is stated that if the colour of the solution is adsorbed by the filter and tends to mask the pink colour, the difficulty can be overcome by washing through the paper a drop or two of phenolphthalein solution. Anyway, the pink colour left on the filter fades rapidly, owing to the action of the carbon dioxide in the air. Conversely, coloured alkaline solutions can be titrated in a similar manner by N/10 acid.

DETERMINATION OF MALTOSE OR LACTOSE IN THE PRESENCE OF OTHER REDUCING SUGARS. M. Legrand. *Comptes rendus*, 1921, 172, 602-604.

Barfoed's solution of copper acetate and acetic acid⁴ is reduced by hexose sugars, but not by disaccharides. In determining hexose sugars by the use of this reagent, 5 c.c. of the sugar solution containing at the most 0.1 gm., are boiled with 15 c.c. of Barfoed's solution for 3 min. in a conical flask, the cuprous oxide thrown down being subsequently collected and estimated volumetrically as in Bertrand's method.⁵ If disaccharides are present, they are hydrolysed and the total reducing sugars then determined by one of the usual methods using Fehling's solution.

RECOMMENDATIONS FOR INCREASING THE TONNAGE OF BEETS GROWN IN THE ARKANSAS VALLEY, COL., U.S.A. J. G. Lill. *Facts about Sugar*, 1921, 12, 112-113 and 134 135.

This is the result of an enquiry made by the Office of Sugar Plant Investigations, U. S. Department of Agriculture, into the conditions prevailing in the locality named, and the recommendations made concern: crop rotation; manuring; irrigation; and details of cultivation (ploughing, planting, thinning).

¹ WALPOLE: *Biochem. J.*, 1913, 7, 410. ² *J. Wash. Acad. Sc.*, 1916, 6, 481.

³ It is obtainable from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 7d. (including postage).

⁴ *J. Chem. Soc.*, 1873, 1163.

⁵ *I.S.J.*, 1915, 236; 1919, 354.

COST OF MANUFACTURE OF BEET SUGAR IN A GERMAN FACTORY. *Financial Report of the Stralsund (Pomerania) Sugar Factory, Germany, 1920-21.*

As in the previous campaign, the Stralsund factory worked up the roots of the Barth factory, and even then the total amount was small compared with pre-war campaigns. The following figures are of interest as being among the first to show the cost of manufacture per 50 kilos of roots in post-war years, as compared with pre-war times (the cost of the roots not being included):—

	1920-21.	1919-20.	1918 19.	1914-15.	1913-14.
Total roots worked, in zentners (of 110·23 lbs.)	668,750 ..	607,560 ..	800,700 ..	2,605,820 ..	2,687,420
Roots worked daily, also in zentners	16,290 ..	— ..	— ..	28,440 ..	28,740
Staff salaries	298 ..	126·43 ..	44·11 ..	7·97 ..	8·52
General expenses	5 ..	1·84 ..	0·87 ..	0·28 ..	0·15
Taxes	71 ..	23·23 ..	9·61 ..	1·13 ..	1·17
Insurance	23 ..	8·30 ..	2·47 ..	0·31 ..	0·27
Cost of manufacture	19 ..	8·18 ..	3·85 ..	1·0 ..	1·22
Repairs	21 ..	9·26 ..	4·53 ..	0·90 ..	1·12
Lime and coke	22 ..	6·0 ..	4·48 ..	2·12 ..	2·27
Coal	194 ..	69·78 ..	26·08 ..	8·50 ..	7·51
Filter-press cloth	29 ..	9·67 ..	5·18 ..	0·55 ..	0·53
	682 ..	262·69 ..	101·18 ..	22·76 ..	22·66
Interest	11 ..	6·42 ..	5·45 ..	0·02 ..	0·80
Total cost of manufacture, pfennigs ..	671 ..	256·27 ..	95·73 ..	22·78 ..	21·86

CONTINUOUS SULPHITATION OF THICK JUICES AND SYRUPS IN BEET SUGAR MANUFACTURE.

A. Hase. Zeitschrift für Zuckerindustrie der czechoslovakischen Republik, 1921, 45, No. 25, 171-172.

If the sulphitation of the thick-juice be carried out in the carbonatation tanks, those parts of the vessels above the level of the liquid, as the covers and vapour pipes, are damaged by corrosion. It is preferable to sulphite continuously in a separate apparatus. An arrangement is described (and illustrated) according to which the thick juice is treated with the sulphurous acid in an enlarged portion of the pipe between the thick juice pump and the filter-presses, the unabsorbed vapours passing to the atmosphere. It is stated that by the regulation of a valve attached to the line from the sulphur ovens, the degree of sulphitation can be controlled in a satisfactory manner, the course of the operation being observed by samples taken from test-cocks placed in the pipe before and after the admittance of the gas. Ease of operation, efficient control of the process, and economy of sulphur are the advantages claimed for this arrangement.

TASTE, AROMA, AND COLOUR OF ARTIFICIAL HONEY *Berthold Block. Zucker, Frucht, und Gemüservwertung, 1921, 2, No. 10, 37-38.*

In Germany "artificial honey" is prepared in certain of the beet factories by the inversion of syrup¹; and the author discusses the improvement of the taste, aroma and colour of the products thus obtained. Certain commercial essences are recommended for imparting a flavour resembling that of true honey.

GUM ARABIC, ITS COLLECTING, MARKETING, AND CHEMICAL CHARACTERISTICS. *J. A. Ridgway. Canadian Chemical Journal, 1920, 4, 330-4.*

A PSEUDO-TANNIN OBTAINED FROM SORGHUM. *A. Stadnik. Chem. Listy, 1920, 14, 140-2.*

¹ See also *I.S.J.*, 1921, 47.

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GUMMING DISEASE OF CANE, ITS CAUSE AND CONTROL *G. Wilbrink. Archief, 1920, 23, 1399-1525.*

SACCHARIN, "A DELETERIOUS AND HARMFUL COAL TAR DRUG." *R. E. Rose and A. M. Henry. La. Planter, 1921, 66, No. 16, 253-255.*

Numerous quotations from various authorities regarding the injurious effect on the human system of the continued use of saccharin have been collected, and should be found of value to those who may have occasion to debate the question. A few may be here reproduced. Thus, Dr. CHARLES H. LA WALL, chemist to the Pennsylvania Food and Drug Department, says: "As an antiferment, or preservative, it is credited with being more harmful than sodium benzoate, salicylic acid, or sulphurous acid. When used it not only exerts a detrimental influence upon certain functions of the body, but it cheats the organism out of a valuable food product—sugar. . . ." In the "Physicians' Manual of the U.S. Pharmacopœia, it is stated that "Saccharin should be used, if at all, with care." Dr. H. W. WILEY wrote in 1911 that "the continued pouring of a foreign body of this kind, which must have very active properties, through the delicate cells of the kidneys cannot fail in time to produce serious disturbances of function and even fatal disease. That and the other reasons which have been so ably presented by many authorities are sufficient to convince me beyond any reasonable doubt that the use of saccharin in any quantity is necessarily injurious. . . ." Holland's "Medical Chemistry and Toxicology" says that saccharin "retards the action of the enzymes in the digestive fluids and also those of the blood and tissues. To a certain extent it depresses general metabolism. . . ." This last opinion is confirmed in several other textbooks on Therapeutics.

ECONOMICAL UTILIZATION OF EXHAUST STEAM FOR HEATING PURPOSES, AND THE USE OF COMPRESSED STEAM IN EVAPORATION. *C. E. Stromeyer. Memorandum by the Chief Engineer, Manchester Steam Users' Association,¹ 1920.*

In explaining the economy of heating by means of back pressure steam from engines, the following figures were presented relating to (1) a condensing engine of 100 H.P. (= 210 lbs. steam, or 20 lbs. of coal); and (2) a high-pressure non-condensing engine, also of 100 H.P., giving exhaust against 60 lbs. absolute pressure:—

Heat supplied to the Boiler.		Lost in the Chimney and by Radiation, in lbs.	Passing to the Engine, in lbs.	Waste to Condenser; or Exhaust to the Engine, in lbs.	Utilized in the Engine, in lbs.
Steam, in lbs.	Coal equivalent, in lbs.				
(1) 1,500	.. 140	.. 450	.. 1050	.. 840	.. 210
(2) 10,670	.. 980	.. 3170	.. 7400	.. 7190	.. 210

If instead of 60 lbs. absolute back pressure assumed in case (2) in the table, 30 lbs. absolute were to be adopted, the weight of exhaust would be about 5300 lbs., instead of 7190 lbs., the steam supply to the engine 5510 lbs., the chimney waste 2360 lbs., and the heat supply to the boiler would be equivalent to 7870 lbs. of steam, say 730 lbs. of ordinary coal. In the case shown in (2) in the table there would be available for heating purposes at 45 lbs. pressure or 292°F., about 7190 lbs. of steam per hour capable of heating about 3600 gall. of water per hour to boiling point. In the case in which the available pressure is 15 lbs. or 250°F., the heating capabilities would be 2650 gall. per hour. In both cases the 100 H.P. would cost practically nothing, viz., 210 lbs. of steam, or 20 lbs. of ordinary coal. In other words, when all the steam can be utilized for heating or other purposes, the power derived from it costs practically nothing. It is therefore highly economical for those works which use much steam for heating to produce power with it, and use or sell it; and for those which produce much power to sell their waste steam for heating purposes to other factories requiring it.

¹ Founded in 1854 by Sir WM. FAIRBAIRN, F.R.S., Sir JOS. WHITWORTH, F.R.S., and others "for the prevention of steam boiler explosions and for the attainment of economy in the application of steam."

In another part of the "Memorandum," the use of thermo-compression evaporators for the production of distilled water in print and dye works is discussed. To condense steam for the sake merely of the condensed water would cost 20s. per 1000 gallons with coal at 36s. per ton. By, however, withdrawing vapour from one side of the heating surface of an evaporator, compressing it mechanically, and delivering it against the other side, nearly all the latent heat can be regained at the cost of the power used for suction and compression. Even this power is not lost, for it appears in the condensate as excess temperature. If this excess temperature were kept as low as 10°F. (which is only a question of evaporating surface), the cost of producing distilled water would be reduced to 1 per cent. of the value given above; and if by doubling the evaporator surface, the temperature difference were reduced to 5°F., the cost would be 1½d. per 1000 gallons. This idea has been the subject of many inventions during the past 70 years*; but the practical results have fallen far short of the ideal. Multiple rotary compressors driven by electricity utilize at most 5 per cent. of the heat in the furnace fuel, and are therefore very expensive, except in works where back pressure steam is used for heating. Cylinder and piston compressors are somewhat more efficient; while steam jets, in spite of their mechanical inefficiency, seem to have given the best results. Internal combustion engines have not yet been used for compressing the vapours, but their efficiency ought to be a high one, and their heat losses in the exhaust and cooling water would be transferred to the evaporator. Probably the best arrangement (though it has not been suggested in published articles) would be to use steam-engine compressors, the steam exhausting into the evaporator, since then the compression power would cost only a trifle, and the exhaust steam would add heat. Finally, it is needless to say that the highest possible efficiency can only be attained if the feed and condensate pass through a counter-current heater.

USES OF COMPRESSED AIR IN THE MODERN SUGAR FACTORY. *D. L. Thomson.*
Compressed Air Magazine; through *Sugar*, 1921, 23, No. 4, 207-208.

Mr. THOMSON outlined for the use of the general reader the process of cane sugar manufacture, emphasizing the purposes for which compressed air has been, is, or might be used, namely: the supply to the sulphur oven of a regulated amount of oxygen; the active circulation of the limed juice during sulphitation; the operation of the filter-presses by means of a *monte-jus*; the automatic removal of the condensed vapours in the heating chambers of the evaporator; the maintenance of a constant working level of the juice in the four vessels of the quadruple; the discharge of the massecuite from the pans and crystallizers; and lastly, the operation of rotary tube cleaners or scrapers to remove the scale from boilers and evaporators.

PER CAPITA CONSUMPTION OF SUGAR IN DIFFERENT COUNTRIES. *L. W. Alwyn Schmidt.*
Sugar, 1921, 23, No. 4, 192-194.

A study is made of the various factors contributing to *per capita* consumption of sugar in any country. One must consider separately: the custom of the country in regard to the domestic use of sugar, the amount, for example, it is usual to use for the sweetening of tea, coffee, or other beverage; and the amount used in cooking, and in canning, that is the preparation in the home of jam, jelly, marmalade, and preserved fruit. Thus, on going into the statistics relating to these points (so far as they are available), it is found that the United Kingdom leads in tea consumption, also appears high on the list in regard to coffee consumption, and goes in largely for making preserves and preserves in the home. This would largely explain the fact that before the war this country consumed most sugar per head, excepting Denmark and Australia. At the same time, however, one must consider what may be termed the industrial consumption of sugar, that is, the amount used in baking and confectionery, and the manufacture of cocoa and chocolate, condensed milk, "soft drinks," flavouring syrups, and the like. In America since pre-war years, a large increase of

* For some recent patents see *I.S.J.*, 1920, 58, 117, 418, 713; 1921, 297.

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production (probably about 33 per cent.) in the candy and chocolate industries has taken place, and condensed milk has also been manufactured in greater amount; but "the coming of the soft drink industry seems to be the only important factor in the economic situation of the United States making for an increase in industrial sugar consumption in excess of the usual progress caused by the growth of the nation"

INFLUENCE OF AMMONIUM MOLYBDATE ON THE ROTATORY POWER OF SUGARS. *Georges Tanret. Comptes rendus, 1921, 172, 1863-1865.*

Measurements of the alteration of the rotatory power of some sugars where ammonium molybdate is added are given. Thus the $[\alpha]$ of dextrose is raised from $+52.5$ to 54.1° ; and that of levulose from -90 to -50° . In the case of the C_{12} , C_{18} , and C_{24} sugars and inulin, the salt has no effect; and it is suggested that this property might form the basis of a rapid method for estimating one known hexose sugar in admixture with other sugars the rotatory power of which remains unaltered in the presence of the molybdate.

PREVENTING (SUGAR) DUST EXPLOSIONS. *David J. Price. Chemical and Metallurgical Engineering, 1921.*

This is a short review of the literature¹ relating to the ignition temperatures of gases and dusts; velocity of flame; pressures developed; and relation of humidity to explosion frequency.

ULTRAMARINE BLUE MANUFACTURE. *M. Sauvageot. La Revue des Produits chimiques, 1921, 24, 141-148; 205-212.*

Raw materials comprise mineral substances, as kaolin, silica (e.g. kieselguhr), sulphur, chemical products, as sodium carbonate (e.g. soda ash), hydroxide, sulphate; and "reducers," as wood, charcoal, resin, tar pitch, all in a state of high purity, iron and calcium being constituents that should be especially avoided. In this useful article the proportions of the ingredients for blues of six different types are given, together with particulars regarding mixing and grinding, and details of the calcining operation.

YIELDS OF ALCOHOL FROM WOOD WASTE. *Anon. Chemical and Metallurgical Engineering, 1921, 24, No. 5, 213*

According to the writer, the only feasible method of utilizing lumber mill refuse on a large scale is to convert it to alcohol. In the case of soft-wood waste (that from pine, spruce, etc.) the wood convertible into sugars is 20-23 per cent.; the sugars that are fermentable is 66-74 per cent.; and the amount of 95 per cent. alcohol from one ton of wood is 20.7-25.8 per cent. Somewhat lower figures obtain in the case of hard-wood waste. An alcohol plant with a daily supply of 180 tons can produce 3000 gallons of 95 per cent. alcohol at approximately 25 cents per gallon.

"ALCOGAS" AVIATION FUEL. *V. R. Gage, S. W. Sparrow and D. R. Harper. Report No. 89, U.S. Advisory Committee for Aeronautics, 1920.*

COST OF SYNTHETIC ALCOHOL. *Anon. Journal de l'Acetylene, 1920, November.*

Alcohol was produced synthetically in Germany and Switzerland during the war to make good the shortage of petrol, acetylene being converted into ethyl aldehyde and hydrogen added. To produce 1 kg. of alcohol, however, 1.6 kg. of calcium carbide and 0.45 kg. of hydrogen are theoretically necessary, which quantities in practice should be increased by about 20 per cent., making the cost of the raw materials $2\frac{1}{2}$ francs per kg. Although the Swiss works are closed now, it is possible in the event of the price of calcium carbide being reduced that alcohol may be made in this way in commercial quantities.

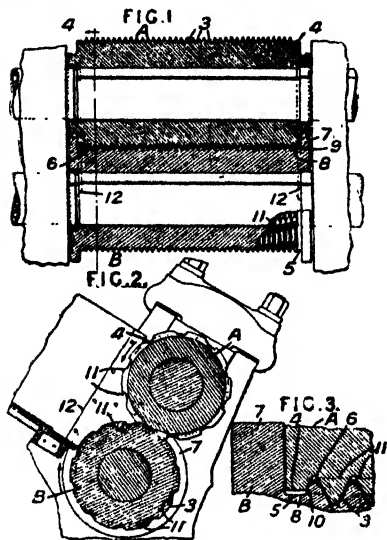
¹ Refer also to: *Chem. and Met. Eng.*, 1920, 23, No. 13, 915; *Trans. Chem. Soc.*, 95, 517; *U.S. Dept. Agric., Bull.* 379; *U.S. Bureau of Mines, Technical Paper* 150; *J. Ind. Eng. Chem.*, 9, No. 3, 269; *Chemical Engineer*, March, April and May, 1908.

Review of Recent Patents.

UNITED KINGDOM.

CRUSHERS FOR CANE MILLS. *L. W. Gould* (communicated by the *Fulton Iron Works Co.*, of St. Louis, U.S.A.). 162,975 (21,438). July 16th, 1920.

In cane mills or crushers having rolls with peripheral ribs and grooves, the ribs and grooves terminate at abrupt shoulders to prevent lateral displacement of the material at



the ends of the rolls. The grooves at the ends of one roll are provided with walls which form abrupt shoulders, while the other roll is provided with end ribs to confine the material in the corners formed by the abrupt shoulders. As shown, the upper and lower rolls *A*, *B* have end ribs *4*, *6* of less depth than the intermediate V-shaped ribs *3*, and end flanges *7* of the lower roll overlap the ends of the upper roll. Each of the end grooves *5* of the lower roll has a base wall *8* parallel to the axis of the roll, an outer side wall *9* approximately at right-angles to the wall *8*, and an inner side wall *10* at an obtuse angle to the wall *8*. The end ribs *4* of the upper roll conform to the shape of the end grooves *5* and the shoulders formed by the walls *9* tend to prevent lateral displacement of any material forced into the grooves *5*. The intermediate ribs *3* may be notched as at *11*, but the end ribs *4* are comparatively smooth. To minimize the delivery of cane to the end grooves *5*, baffles *12* are arranged at the intake side of the rolls. Each baffle has an arcuate lower edge situated in an end groove *5* and contacting with the base wall *8* of the groove, and an upper arcuate edge conforming to and contacting with the smooth periphery of an end rib.

FILTER. *United Filters Corporation*, of New York, U.S.A. (assignees of *O. J. Salisbury*, of Salt Lake City, U.S.A.). 146,231 (17,538). June 28th, 1920; convention date, May 24th, 1917; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

A series of rotary disc suction filters are mounted on a hollow shaft, each disc dipping into a separate narrow tank containing the liquid to be filtered. The filtrate is discharged through passages in the shaft and means are provided for spraying the discs with wash-water and for scraping off solid matter deposited on the discs.

DECOLORIZING CARBON PREPARATION. *I. Szarvasy*, of Buda-Pest. 158,889 (4376). February 7th, 1921; convention date, July 18th, 1918; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Finely divided carbon, suitable for use as an adsorbing agent, is obtained by the thermal decomposition of methane previously diluted with a neutral gas, such as nitrogen, hydrogen, or carbon dioxide, which does not itself deposit carbon.

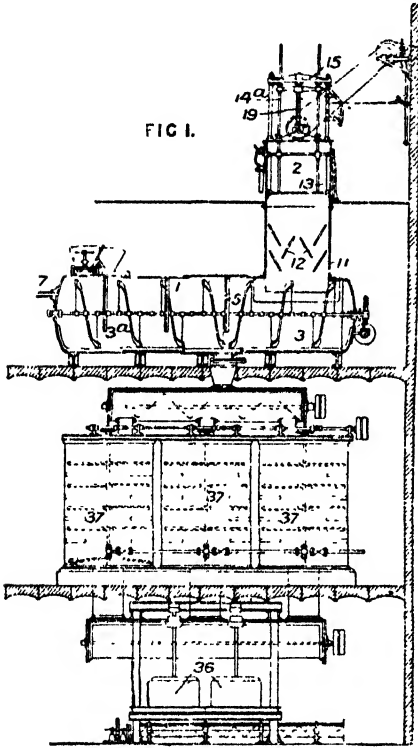
¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Patents.

PURIFYING LIQUIDS (E.G., SUGAR JUICES OR SYRUPS WITH DECOLORIZING CARBON, ETC.).

A. J. H. Haddan (communicated by the *Naamloze Vennootschap Algemeene Norit Maatschappij*, of Amsterdam, Holland). 163,505 (5707). Feb. 26th, 1920.

Liquid (as sugar juice or syrup) is thoroughly mixed with purifying material in a container through which the liquid is passed continuously, any purifying material (as decolorizing carbon) carried forward by the liquid being retained by a separating-device within the apparatus, removed from the separating-device by mechanical means, and brought back to act on the liquid passing through the container. This process can be applied in the purification of sugar juices or syrups, alcohol, oils and fats, glycerin, water, etc.; and suitable purifying materials are decolorizing carbon, finely powdered charcoal, kieselguhr, and fuller's earth.



The mixing-container 1 is provided with baffles 5 and stirrers 3, arranged to direct the purifying material towards the centre. The liquid is supplied through the inlet 7 and passes away through a vertical cylinder 11 and filter 2. Baffles 12 promote the settlement in the cylinder 11 of material carried by the liquid and the remainder is deposited on cloth-covered filter frames 13, from which it is removed by scrapers so that it falls back through the cylinder 11 to the mixing-cylinder 1. The scrapers are supported on rods 14a from a cross-head 15, which moves up or down on a screwed spindle 19 as the spindle is rotated. Means are provided for automatically changing the direction of rotation when the scrapers reach the end of their travel in either direction.

The liquid may be passed through a series of such apparatus, different or less exhausted purifying materials being used in the later containers of the series. The purifying material may be treated with a washing or extracting agent in the cylinder 1 or in agitating vessels 37 and centrifugal separators 36. Decolorizing carbon which has been once used may have any adhering liquid separated from it mechanically and be then used without intermediate revivification for treating a more impure liquid.

CENTRIFUGALS. (1) **C. Lumpp**. 159,839 (7027). March 3rd, 1921; convention date, March 3rd, 1920; not yet accepted; abridged as open to inspection under Section 91 of the Act. (2) **H. A. Gill** (*Sharples Speciality Co.*, of West Chester, Penn., U.S.A.). 160,112 (18,906). March 17th, 1921.

HYDROMETERS. **J. H. Kessler**, of Vineland, New Jersey, U.S.A. 162,240 (32,622). November 18th, 1920.

The hydrometer belongs to that type in which the liquid material under examination (fruit juice, vegetable pulp, jelly, etc.) is sucked up through a cock into a bulb until it reaches a certain mark on the neck, the cock closed, and the instrument immersed in water, the reading being taken on a scale above the neck of the bulb.

CONFECTIONERY MANUFACTURE. *Vacuum Candy Machinery Co.*, of Chicago, U.S.A. 156,702; 156,703 (736; 737). January 7th, 1921; convention date, January 16th, 1914; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

In the preparation of candies and the like, a mixture of cane sugar with cream of tartar, glucose, natural lemon juice, citric or tartaric acid or other "reversion-preventing agent" and water is heated, at atmospheric pressure, to a temperature above the cracking point but below that required to complete "cooking," a partial vacuum being created to complete the operation at that temperature. A vacuum apparatus is also described.

CONFECTIONERY DECORATION. *W. V. Dawkings*, of Whitstable, Kent. 161,740 (2967). January 30th, 1920.

GRINDING CHOCOLATE, ETC. *E. C. R. Marks*, (*National Equipment Co.*, of Springfield, Mass., U.S.A.). 159,527 (22,679). September 15th, 1919.

EXTRACTING FAT FROM COCOA, ETC. *C. A. Fankhauser*, of Geneva, Switzerland. 158,844 (3922). February 2nd, 1921; convention date, February 3rd, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

APPARATUS FOR THE MANUFACTURE OF CHOCOLATE CREAMS. *N. E. Brigham*, of Holyoke, Mass., U.S.A. 160,700 (15,720). June 10th, 1920.

WEIGHING MACHINE. *B. Boulogne*, of Soerabaja, Java 158,515-158,516 (2999-3000). January 24th, 1921; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

In an automatic weighing machine for liquids or granular substances, the weigh-beam consists of a bent lever provided with a counterbalance weight, which returns the lever to its original position after the discharge of the weighed material.

FILTERS. *W. J. Still*, of Westminster, London. 161,639 (325). January 5th, 1920.

The frame of a filter leaf is provided with a plurality of coil springs disposed longitudinally within the frame in such spaced relation that the overlying bag substantially encloses each spring separately, so that the spring constitutes a pipe for the conveyance of the filtered liquid to the outlet.

GUM PREPARATIONS. *H. V. Dunham*, of 347, Madison Ave., New York. 160,045 (1814). January 20th, 1920.

Water soluble products (which may be used in confectionery manufacture, etc.) are prepared from Kayara gum by dissolving it in water containing a non-oxidizing alkaline substance (e.g., sodium bicarbonate), and drying the resulting solution.

TUBE-SCRAPERS. (1) *A. & W. Smith & Co.*, of Glasgow, N.B. (*L. H. A. Ducasse*, of Renishaw Estate, Natal). 160,362 (3365). March 20th, 1920. (2) *Fawcett, Preston & Co., Ltd.* (*H. W. Taylor*). 162,525 (10,479). April 15th, 1920.

CONTINUOUS FERMENTATION PROCESS. *A. Römer*, of Stuttgart, and *Deutsch-Koloniale Gerb-u.-Farbstoff Ges.*, of Karlsruhe, Germany. 161,870 (16,395). June 17th, 1920.

A continuous process for the industrial fermentation of solutions containing sugar consists in passing the liquid through a series of closed vessels containing filters impregnated with yeast or other ferment, the rate of flow being adjusted so that complete fermentation is effected, and the order of the vessels being changed from time to time to prevent destruction of the ferment. In addition to ordinary fermentation, this process is applicable to fermentations giving rise to glycerin, butyl alcohol, lactic acid, etc.

Patents.

SAND FILTER. *L. E. Raimbert*, of Seine, France. 160,762 (5883). February 21st, 1921; convention date, March 23rd, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

STRAINER FOR CANE JUICE. *J. Y. Johnson (F. W. Fischlein, of New York, U.S.A.)*. 161,822 (3943). March 26th, 1920. See also U.S. Patent, 1,343,078.¹

PRESERVATION OF EXHAUSTED BEET SLICES, ETC., FOR CATTLE FOOD. *A. Stouffs*, of Brabant, Belgium. 161,885 (21,673). July 19th, 1920.

Industrial residues, such as the spent grain from breweries and distilleries, the exhausted slices of beet sugar factories and the residues from oil mills, jam factories and wine and cider presses to be used as food for animals, are preserved by treatment with a mixture of 1 kg. of 33 per cent. fuming hydrochloric acid with 200 litres of water per 1000 kgs. of the substance to be treated. The solution is made up just before use and sprinkled over the products to be treated.

PREPARATION OF DECOLORIZING CARBON FROM REFINERY OIL-CAKE RESIDUES. *De Bruyn Ltd., and Cecil Revis*, of Barnes, London. 162,117 (3698). February 6th, 1920; April 28th, 1921.

A decolorizing carbon is prepared from the waste filter-press residues from the refining of edible oils, such as cotton-seed oil or shea-nut oil, by heating them in a reverberatory or similar furnace at a temperature just above the flash-point of the oil they contain, and with restricted admission of air. The product, which is a porous carbonaceous mass, is cooled out of contact with the air, washed with dilute acid to neutralize any alkaline salts formed by the incineration of contaminating soaps, and finally pressed into cakes and dried. Lampblack is collected as a combustion product in the flue of the furnaces. No claim is made to any revivification or to any decolorizing powers which may be possessed by the fuller's or silicious earths or animal charcoal or other decolorizing carbon which may be present in the raw material used in this process, and which may possibly be revived to some extent by the heating. Such substances act only as a porous base for the deposition of the decolorizing agent formed by the imperfect combustion of the oil present.

LACTOSE MANUFACTURE. *J. Tavorges, J. W. Roche, and G. Martin*. 161,887 (22,019). July 22nd, 1920.

In manufacturing lactose from whey,² the lactalbumen is precipitated by the addition of a substance which produces in the whey a suitable colloid. It is suggested that the precipitation is due to the production of a negatively-electrified colloid in presence of the albumen. Sodium thiosulphate, yielding colloidal sulphur, is stated to be suitable. The whey may be heated to 70-80° C. before adding the precipitant.

MOTOR FUELS CONTAINING ALCOHOL AND ACETYLENE. (1) *Percy H. King*, of Bryanston Square, London. 112,741 (11,478). August 10th, 1917. (2) *John Penhale*, of Johannesburg, B.S.A. 120,792 (17,858). December 3rd, 1917.

(1) Any suitable alcohol (preferably ethyl) or mixture of alcohols is vaporized, and then mixed with acetylene generally in the proportion of volume for volume, the alcohol vapour and acetylene being condensed. The resulting liquid having the acetylene in solution is more readily ignitable when used as a fuel in external combustion engines. (2) Alcohol is substantially saturated with acetylene at normal pressure; that is, is caused to take up about six times its own volume of the gas. As the acetylene is readily soluble in the alcohol, the desired saturation may be effected by merely passing in small bubbles into the liquid. Acrolein, in the amount of 1 per cent. by weight is added as denaturant.³

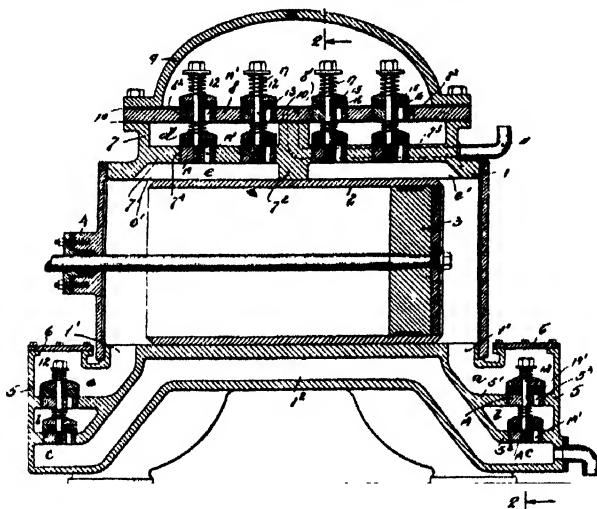
¹ This is the Carter Juice Strainer. See *I.S.J.*, 1920, 715. ² See also *I.S.J.*, 1920, 239.

³ This is "Penrol" motor spirit. See *I.S.J.*, 1921, 471.

UNITED STATES.

DOUBLE-ACTING HIGH-PRESSURE PUMP FOR SYRUP. *Eloy Rodriguez*, of Fajardo, Porto Rico. 1,342,719. June 8th, 1919. (Four figures.)

On moving the piston from its end position, the suction created at the right end of the cylinder 1 will allow the double valve 15 at the right lower end of the cylinder to be raised by the pressure of the liquid flowing into and filling the passage 1² of the pump, while the left-hand lower double valve will be maintained in closed position owing to the compression at the opposite end of the cylinder. The liquid will enter the cylinder through the raised right-hand lower valves, which valves will remain in raised or open position until the piston begins its return stroke. At that moment the lower right-hand valves will close, while the lower left-hand valves and the right-hand upper valves will open. In consequence thereof the liquid will enter the cylinder through the passage 1' at the left end thereof,



and the liquid previously raised in front of the piston will be forced through the right-hand upper valves into the dome 9 and thence through passages 8', 7² and pipe 11 into the transfer pipe (not shown). During the next stroke the pressure at the rear of the piston will cause the liquid to open the left upper valves and to pass into the dome and thence through passages 8' and 7² to the transfer pipe, while fresh liquid will pass into the pump through the lower right-hand valves as already described.

Once started the pump will become entirely filled with the liquid, and the slightest movement of the piston forward or backward will cause a discharge of the liquid into the dome. In this manner a continuous pumping action and such high pressure is obtained as will enable to raise the liquid to a high elevation. The advantage of using double valves both at the inlet and discharge of the pump is that in case of injury to any one of the valve bodies of a double valve, the work of the pump need not be discontinued, but can go on until the pump has been entirely emptied.

CONVERSION OF CELLULOSE TO FERMENTABLE SUGARS FOR ALCOHOL PRODUCTION.

Rudolph A. Kocher, of San Francisco, Cal., U.S.A. 1,374,928. April 19th, 1921.

The process described consists in treating cellulose (wood, etc.) with a halogen acid of 39 per cent. or over, and of critical strength, in the presence of hydrochloric acid gas under pressure greater than atmosphere, the amount of water present being less by weight than the dry weight of the material used.

Patents.

CHOCOLATE COOLING MACHINES. *Henry C. Gates*, of Cedar Rapids, Iowa, U.S.A. 1,375,380. April 19th, 1921. (2) *Emile Savy*, of Paris, France. 1,375,734. April 26th, 1921.

CANDY PACKING TABLE. *John E. Davis*, of Cincinnati, Ohio, U.S.A. 1,366,169. January 17th, 1920; January 18th, 1921.

EVAPORATORS. (1) *John T. Wann* (assignor to *Robert C. Newell and Wm. C. Murdock*) of San Francisco, Cal., U.S.A. 1,375,431. April 19th, 1921. (2) *Charles F. Purinton*, of Burlington, Vermont, Vt., U.S.A. 1,376,578. May 3rd, 1921.

CENTRIFUGALS. (1) *Edwin D. Gray*, of Richmond, Calif., U.S.A. 1,375,506. April 19th, 1921. (2) *Edward W. Beach*, of Winnetka, Ill., U.S.A. 1,373,219. March 29th, 1921.

FILTERS. (1) *Frank K. and Earl F. Atkins*, of New York, U.S.A. 1,350,433. August 24th, 1920 (Five figures.) (2) *John J. Naugle*, of Brooklyn, New York, U.S.A. 1,377,022. May 3rd, 1921.

CENTRIFUGAL HONEY EXTRACTOR. *Huber H. Root*, of Medina, Ohio, U.S.A. 1,363,999. April 6th, 1914; December 28th, 1920.

TREATING SPENT WASH, VINASSE, OR DISTILLERS' SLOPS FOR THE RECOVERY OF GLYCERIN. *Harry P. Bassett*, of Cynthiana, Kentucky, U.S.A. 1,357,138. October 26th, 1920. (No drawing.)

Spent wash from the distillation of fermented black-strap molasses contains some unfermentable sugars, starches and gums, the presence of which (it is said) interferes with the satisfactory and economical separation of the glycerin present. It is therefore filtered, and treated with 2-4 per cent. of a soluble salt of a metal adapted (a) to form hydroxides of different degrees of oxidation, and (b) to form an insoluble basic salt with acids of the volatile fatty acid series, ferrous or ferric sulphate or manganous or manganic sulphate being preferably employed. This addition is made at boiling point, and the boiling continued for 5-10 min. afterwards. Now a sufficient quantity of an alkaline earth hydroxide, preferably calcium hydroxide, is added to form the metallic hydroxide, slightly more than the weight of iron or manganese salt added being used. After several hours' boiling, during which operation air is blown into the liquid, filtration and acidification follows. Finally, the liquid is evaporated to about 5 per cent. of its original volume, during which process about 60-70 per cent. of the potash salts crystallize out, after the separation of which steam-distillation for the recovery of the glycerin is effected.

RECOVERY OF PROTEIN AND CALCIUM AND MAGNESIUM PHOSPHATES FROM ACID WASTE WATERS OF STARCH MANUFACTURE. *Adolph Giesecke*, of Buffalo, New York, U.S.A. 1,354,822. October 5th, 1920. (One drawing.)

Ordinarily in starch manufacture the corn is steeped in a solution of sulphurous acid, milled, washed, again sulphited, and the separation of the starch effected by running the milky mass over tables, the "tailings" which do not subside being later separated from the acid water in settlers and worked up into a feed product known as gluten meal. This acid water contains protein and phosphates which usually are lost. Therefore, according to this invention the "tailings" are neutralized with sodium carbonate to give an acid salt, at which stage the protein and phosphates are precipitated from the waste water in a state of considerable purity and are mixed with the solids of the "tailings," thus forming after filter-pressing and drying a rich gluten meal.

DRYING APPARATUS MORE PARTICULARLY FOR BEET PULP. *Frank V. Burman*, of Marine City, Michigan, U.S.A. 1,336,422. April 13th, 1920. (Four figures.)

Claim: In a drying apparatus, a rotatable drum and radially extending partition plates in the drum provided with apertures and laterally extending stirrer projections, said plates being arranged alternatively at an angle to each other.

PREPARATION OF DECOLORIZING CARBON FROM COALY MATTER, AMMONIACAL LIQUOR, ETC. *Russell W. Mumford* (Assignor to *Refining Products Corporation*, of Delaware, U.S.A.). 1,359,094. November 16th, 1920.

As the inventor has explained in a previous specification,¹ it is better not to have the raw material from which the carbon is made too solid in structure. Therefore, he mixes powdered lignite or any other coal or coaly material high in volatile matter with a tarry liquid, such as the residues of tar distillation to which advantageously ammoniacal liquor may be added. On heating slowly to a temperature ending above 600°C., a product highly efficient as a decolorizing and clarifying agent is obtained. In some cases the coaly matter may be mixed with milk-of-lime, or a mixture of milk-of-lime and a solution of monocalcium phosphate, and charred in the same way, but ammoniacal tar is preferred. A certain proportion of mineral spacing agent, which is advantageously dolomite, may be incorporated with the other materials prior to forming the dough. In order to sweep out the volatile products formed in charring, a current of steam or of the products of combustion may be blown through the retort. In an advantageous method of charring, sometimes employed by the inventor and previously mentioned by him,² the mass to be charred is placed in shallow covered trays, which are passed through a tunnel-like chamber heated by "surface combustion," no oxygen to waste away the material being charred being present in the gases thus used. Finally, the carbon is cooled by continuing to blow in the steam, or it may be moistened; and the mineral matter, if any has been added, may be removed by sedimentation and extraction with acids, if desired. In an example given, brown coal ground to pass through a sieve of 80 mesh was mixed with 5-30 per cent. of finely powdered dolomite, and this mixture converted into a dough-like mass with wet ammoniacal gas tar, "using sufficient of the latter to give the desired consistency," this mass being formed into pellets and placed in a vented retort. A current of dried steam was passed through the retort, and the heat gradually raised to 600°C., or higher. Finishing at a very high temperature was found to be necessary, in order to ensure the charring of anything soluble present. It is said that the presence of nitrogen in the product is advantageous in respect of its decolorizing properties.

Beet Crops of Europe.

(*Willott & Gray's Estimates to August 18th, 1921.*)

	Harvesting Period.	1920-21. Tons.	1919-20. Tons.	1918-19. Tons.
Germany	Sept.-Jan...	1,110,000	739,548	1,350,665
Czecho-Slovakia	Sept.-Jan...	680,000	475,877	606,793
Hungary and Austria	Sept.-Jan...	35,000	12,151	
France	Sept.-Jan...	305,000	154,444	110,096
Belgium	Sept.-Jan...	250,000	146,918	74,183
Holland	Sept.-Jan...	318,402	238,692	173,436
Russia (Ukraine, Poland, etc.)	Sept.-Jan...	250,000	226,691	336,616
Sweden	Sept.-Jan...	164,194	145,072	127,467
Denmark	Sept.-Jan...	165,000	152,852	144,600
Italy	Sept.-Jan...	150,000	182,843	106,682
Spain	Sept.-Jan...	200,000	81,650	139,409
Switzerland	Sept.-Jan...	10,000	8,550	10,800
Bulgaria	Sept.-Jan...	7,837	10,974	2,441
Rumania	Sept.-Jan...	5,000	....	....
		3,638,433	2,576,262	3,183,188

¹ U.S. Patent, 1,286,187; I.S.J., 1919, 357.

² U.S. Patent, 1,287,592; I.S.J., 1920, 61.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to August 18th, 1921.)

	Harvesting Period.	1920-21. Tons.	1919-20. Tons.	1918-19. Tons.
United States—Louisiana	Oct.-Jan. ..	150,995	108,035	250,802
Texas	" " ..	6,238	None	4,134
Porto Rico	Jan.-June ..	415,000	433,825	362,618
Hawaiian Islands	Nov.-July ..	527,400	496,183	538,913
West Indies—Virgin Islands	Jan.-June ..	4,500	12,400	9,000
Cuba	Dec.-June ..	3,900,000	3,788,077	3,971,776
British West Indies—Trinidad	Jan.-June ..	50,000	58,416	47,850
Barbados	" " ..	38,000	54,279	75,271
Jamaica	" " ..	45,000	46,875	43,000
Antigua	Feb.-July ..	13,500	16,540	12,841
St. Kitts	Feb.-Aug. ..	8,000	10,036	10,901
Other British West Indies	Jan.-June ..	10,000	5,651	7,580
French West Indies—Martinique	Jan.-July ..	25,000	19,097	10,027
Guadeloupe	" " ..	25,000	25,500	26,604
San Domingo	Jan.-June ..	189,000	175,736	168,309
Haiti	Dec.-June ..	5,000	5,000	3,300
Mexico	" " ..	100,000	92,000	70,000
Central America—Guatemala	Jan.-June ..	15,000	15,000	13,441
Other Central America	" " ..	20,000	20,000	14,240
South America—				
Demerara	Oct.-Dec. and May-June ..	100,000	96,000	107,560
Surinam	Oct. Jan. ..	12,000	12,000	8,000
Venezuela, exports	Oct.-June ..	15,000	18,000	16,970
Ecuador	Oct.-Feb. ..	8,000	7,000	7,000
Peru	Jan.-Dec. ..	350,000	330,000	294,500
Argentina	May-Nov. ..	201,998	298,709	130,161
Brazil	Oct.-Feb. ..	300,000	177,155	183,079
Total in America		6,526,632	6,262,514	6,377,877
Asia—Brit. India (consumed locally)	Dec.-May ..	2,349,000	3,049,157	2,370,000
Java (1922—1,550,000)	May-Nov. ..	1,485,000	1,335,763	1,749,408
Formosa and Japan	Nov.-June ..	342,176	283,482	415,678
Philippine Islands, exports	" " ..	289,000	209,336	195,289
Total in Asia		4,465,176	4,877,738	4,730,375
Australia (1921-22—270,000)	June-Nov. ..	175,000	162,298	209,853
Fiji Islands	" " ..	60,000	60,000	80,000
Total in Australia and Polynesia		235,000	222,298	289,853
Africa—Egypt (consumed locally)	Jan.-June ..	80,000	86,712	75,899
Mauritius	Aug.-Jan. ..	225,000	235,490	252,770
Réunion	" " ..	40,000	32,336	33,273
Natal	May-Oct. ..	140,000	142,851	185,000
Mozambique	" " ..	45,000	38,746	20,615
Total in Africa		530,000	536,135	567,557
Europe—Spain	Dec.-June ..	6,886	6,048	6,618
Total cane sugar crops		11,763,694	11,904,733	11,972,280
Europe—Beet sugar crops		3,638,433	2,576,262	3,183,188
United States—Beet sugar crop	July-Jan. ..	969,419	652,957	674,892
Canada—Beet sugar crop	Oct.-Dec. ..	34,600	16,500	22,300
Total beet sugar crops		4,642,452	3,245,719	3,880,380
Grand total Cane and Beet Sugar	Tons..	16,406,146	15,150,452	15,852,660
Estimated increase in the world's production ..	" " ..	1,255,694	....	....

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING AUGUST 31ST.		EIGHT MONTHS ENDING AUGUST 31ST.	
	1920. Tons	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS.				
Germany .....	....	....	....	....
Netherlands .....	....	....	5,831	....
Belgium .....	....	....	....	595
France .....	....	....	....	....
Czecho-Slovakia .....	....	....	....	....
Java	11,224	1,400	24,574	23,259
Philippine Islands .....	....	....	....	....
Cuba	20,881	9,560	515,958	134,372
Dutch Guiana .....	....	81	58	1,002
Hayti and San Domingo ..	....	....	....	40
Mexico .....	....	....	....	....
Peru	4,367	2,010	29,950	58,076
Brazil	114	1,872	6,001	42,693
Mauritius	1,056	5,319	97,864	186,853
British India	930	15	14,445	1,461
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	5,766	9,349	119,005	82,986
Other Countries	1,481	414	25,895	40,188
Total Raw Sugars.....	45,820	29,820	889,381	571,525
REFINED SUGARS.				
Germany .....	....	....	126	1
Netherlands	2	5,058	1,062	69,909
Belgium	83	35	1,982	16,132
France	266	45	292	2,652
Czecho-Slovakia .....	....	....	102	138
Java .....	....	251	5,010	355
United States of America ..	10,413	28,672	100,616	130,968
Argentine Republic .....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	110	15,700	8,111	113,547
Total Refined Sugars ..	10,875	49,761	117,302	333,702
Molasses	7,371	15,355	55,827	58,690
Total Imports.....	64,066	94,936	1,012,510	963,917

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .....	....	....	....	1
Netherlands .....	....	148	2	1,636
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	225	94	475	1,014
Canada .....	....	....	....	....
Other Countries	37	162	51	1,891
	262	404	528	4,543
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	1,281	68	2,148	290
Unrefined	1,271	330	6,931	2,120
Various Mixed in Bond .....	....	....	....	....
Molasses	86	43	2,611	389
Total Exports.....	2,900	845	12,218	7,342

Weights calculated to the nearest ton.

United States.

(Willott & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920 Tons.
Total Receipts January 1st to August 25th ..		1,780,323 ..	2,361,558
Deliveries		1,787,620 ..	2,359,534
Meltings by Refiners		1,716,844 ..	1,993,735
Exports of Refined		213,000 ..	325,000
Importers' Stocks, August 24th.. .. .		3,755 ..	2,024
Total Stocks, August 24th		104,038 ..	131,990
		1920.	1919.
Total Consumption for twelve months		4,084,672	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

	(Tons of 2,240 lbs.)	1918-19 Tons.	1919-20. Tons.	1920-21. Tons.
Exports		2,457,149 ..	2,988,988 ..	1,602,897
Stocks		1,024,139 ..	383,868 ..	1,410,866
		<u>3,481,288</u>	<u>3,372,856</u>	<u>3,013,783</u>
Local Consumption		60,000 ..	55,700 ..	75,000
Receipts at Ports to July 31st.. .. .		<u>3,541,288</u>	<u>3,428,556</u>	<u>3,088,783</u>

Havana, July 31st, 1921

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR EIGHT MONTHS ENDING AUGUST 31st, 1913, 1920, AND 1921.

	IMPORTS			EXPORTS (Foreign)		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	605,341 ..	117,302 ..	333,702 ..	623 ..	2,148 ..	290 ..
Raw	745,680 ..	839,381 ..	571,523 ..	2,635 ..	6,931 ..	2,120 ..
Molasses	99,374 ..	55,827 ..	58,690 ..	211 ..	2,611 ..	389 ..
	<u>1,450,395</u>	<u>1,012,510</u>	<u>963,917</u>	<u>3,469</u>	<u>11,690</u>	<u>2,799</u>
				HOME CONSUMPTION.		
				1913. Tons.	1920. Tons.	1921. Tons.
Refined			593,465 ..	131,807 ..	310,850 ..	310,850 ..
Refined (in Bond) in the United Kingdom			487,678 ..	532,212 ..	529,071 ..	529,071 ..
Raw			81,592 ..	144,783 ..	86,036 ..	86,036 ..
Molasses			20,514 ..	21,654 ..	8,015 ..	8,015 ..
Molasses, manufactured (in Bond) in United Kingdom ..			24,224 ..	52,457 ..	30,523 ..	30,523 ..
Total			<u>1,207,473</u>	<u>882,943</u>	<u>864,525</u>	<u>864,525</u>
Less Exports of British Refined			16,695 ..	528 ..	4,543 ..	4,543 ..
			<u>1,190,778</u>	<u>882,415</u>	<u>859,982</u>	<u>859,982</u>

Sugar Market Report.

Our last report was dated 4th August, 1921.

During the past month the home market received the support of only a moderate trade demand, to meet which, supplies were readily forthcoming, with the result that values of all descriptions are lower. At the moment the market is dull and quiet, and buyers seem to be unwilling to look ahead for their requirements. Tate's London Granulated is quoted 57s., No. 1 Cubes 62s. per cwt. Spot, Duty paid. Navigation on the river Elbe shows little improvement, and the small lots of Czecho-Slovak crystals, etc., arriving are being sold at about 27s. 3d. per cwt. f.o.b. Hamburg. American Granulated has offered persistent competition for any demand; spot lots are obtainable at 56s. to 56s. 6d. per cwt. Duty paid, and c.i.f. U.K. ports at 28s. to 27s. according to port and nearness of arrival. Belgian crystals have met some demand, more particularly for shipment to India at moments when prices compared favourably with White Javas. Present quotations f.o.b. Antwerp are 23s. October, 21s. 9d. November/December. Second-hand lots of White Javas for September shipment to U.K. ports are obtainable at 22s. 6d. c.i.f.

White Natala on the spot are doing at 49s. to 47s. Duty paid. W.I. Crystallized descriptions have been in good demand, especially medium qualities, and values range from 44s. 6d. to 49s. spot.

Cables from Mauritius report the first New Crop sale by the Syndicate of some 1700 tons Crystals to Bombay, at the equivalent of 25s. c.i.f. and some 3000 tons at 23s. 9d. f.o.b., but it is thought on this side that these prices are reckoned out too fully. Later cables report business at the parity of 23s. c. and f. Bombay.

Total receipts in Cuba to 3rd September, 1921, are given as 3,152,000 tons compared with 3,474,255 and 3,692,127 tons at the same dates in the two previous years. A computation by one authority puts the final production, allowing for the balance to come from centrals still working, at 3,866,000 tons.

These figures serve as a reminder of the problem, as yet unsolved, of how and when the surplus of the present crop will be liquidated. Much advertisement has been given to reported syndicate operations dealing with large quantities of the unsold sugar, but such reports can have no more foundation than is contained in the fact that much sugar is drifting into the unwilling hands of banking interests, as security for advances which probably exceed present market values. Curtailment of the next crop is advanced by some as a feature which will assist the position. Restrictions of the usual replantings would of course diminish the output, but more particularly of the 1922/23 crop; restriction of harvesting, to be of immediate advantage, would need to be practised at the beginning of the crop, which is a difficult problem to solve in itself, unless the planter can find somebody willing to advance the money to "carry on" against his standing canes. In the meantime, the approach of the seasonal falling off in the meltings by American sea-board Refineries will tend to slacken the call for prompt Cuban sugar.

The quotation of the Cuban Selling Committee for 96° c. and f. New York remains at 3½ c., but free sugars coming along are being sold at a concession and latest cables report business in Porto Ricos and Philippines at 4½ c. c.i.f.

The Java market, barring a temporary setback to about 13½ guilders, has maintained a firm tone, considerable quantities having been taken by the Indian markets. Present quotations for Whites f.o.b. are 16½ guilders per picul for September shipment, 15½ guilders October/November; c. and f. Calcutta quoted 23/3 October/December.

Total shipments from the Island during May, June and July were 331,807 tons, as compared with 235,583 tons last year. Shipments to U.K. and Continent amounted to about 40,000 tons, British India 141,000 tons.

Continental crop reports show little improvement since our last report, and it seems certain that owing to the exceptional dryness of the season, the outturn will be below earlier anticipations. France has benefited by rains, but in some parts the outlook is very indifferent; Czecho-Slovakia complains of continued dryness and recent cables estimate the crop at about 570,000 tons, from which it is argued that little more than about 200,000 tons will be left for export.

H. H. HANCOCK & Co.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Report of the Indian Sugar Committee: What about the Funds?

Elsewhere in a second article reviewing this report we deal with the agricultural portion. As will be seen the industry is considered province by province, and the recommendations of the Committee are of a detailed as well as a comprehensive character. The Government of India has for many years paid a good deal of attention to the sugar industry and a great deal of useful work has been done in various centres; and it was with the idea of collecting this scattered information into one office that the Sugar Bureau, to whose work we recently drew attention, was called into being. But it is proposed to go much further, and the Report of the Committee gives the Government of India the opportunity of co-ordinating and unifying Indian sugar research in one central institute with branches all over the country wherever the industry is of sufficient importance. Naturally, the main obstacle in the way of this advance is the financing of the Committee's proposals. That money expended on the industry is likely to be a sound investment is substantiated by the results obtained in the United Provinces, Bombay and Madras. Taking the latter province, of which alone exact figures are available, it has been officially estimated that the work done some years ago at the Samalkota Sugar Farm has at a trifling cost to the Government improved the industry in South India to the extent of 30 lakhs of rupees (£300,000 at the official rate of 2s. the rupee).

But to carry out the Committee's proposals in their entirety will involve a very large outlay, the annual budget being about equal to that voluntarily subscribed by the Java sugar factories. There are practically no large concerns in India to bear the cost of research work, the vast bulk of the cultivation being in the hands of native growers living from hand to mouth, and it is doubtful whether the Government of India will be able to find the necessary funds now that the financial condition has so altered since the Committee drafted their Report. It is too often the case in India that, when a Committee has been appointed to examine any specific subject, the immediate effect is to hold up all advances, however obvious, till the report has been duly printed and considered, and in many cases

years of delay are permitted to intervene before the findings of such a Committee are put into practice. We trust that this will not be the fate of the proposals of the Sugar Committee. But it was probably due to a fear that such delay might be experienced that the Committee has guarded itself by pointedly recommending that work in certain directions should not await the formation of the Sugar Board or the building of the central Research Institute, but should be immediately extended along the present lines. Such is the work of the Sugar Bureau, the Cane-Breeding Station, the work at Shajahanpur in the United Provinces and that at Manjri in Bombay. We trust that these at least may be allowed to proceed with their work uninterruptedly, if they do not receive the prompt extension that the Committee recommends.

The West Indian Agricultural College.

Last month the governing body of the West Indian Agricultural College was formally constituted at a meeting at the Colonial Office. Sir ARTHUR SHIPLEY, F.R.S., Master of Christ's College, Cambridge, is to be the chairman, and amongst the other Governors are Sir D. PRAIN, of Kew, Sir FRANCIS WATTS, Sir NORMAN LAMONT, Mr. G. MOODY STUART, Mr. W. SCOTT HERLIOT, Mr. R. RUTHERFORD, and a number of others officially interested in agriculture. Mr. A. E. ASPINALL, secretary of the West India Committee, has been appointed secretary, having been previously hon. secretary to the Tropical Agricultural College Committee. Rapid progress is being made with the plans for bringing this college into existence, and an architect has been invited to submit designs. Apart from gifts by the colonies concerned, including one of £50,000 from Trinidad, a number of private donations of money have been made, and the gifts of sugar machinery promised by various firms are estimated to be worth £20,000.

Economic Conditions in the British West Indies.

The first annual report to be issued by H.M. Trade Commissioner in the British West Indies has just recently been published by the Department of Overseas Trade, having been compiled by Mr. A. W. H. HALL, of H.M. Trade Commissioner's Office, Trinidad. It deals with the economic and financial conditions of these islands. At the outset Mr. HALL draws attention to the peculiar geographical character of the area included in the term "British West Indies." The Bahamas on the northern extremity are separated from Trinidad in the south by about 2000 miles, while Georgetown, British Guiana, is still more distant from the Bahamas. Jamaica is nearly 700 miles east of British Honduras and over 1000 miles north-west of Barbados. This geographical factor is responsible for considerable differences of climate and soil, and it affects widely the problems of Civil government, industry, and trade; the difficulty of intercommunication between certain of the units is pronounced. The great majority of the population of the West Indies is of negro origin, but in some of the colonies and particularly in Trinidad and British Guiana, there is a large East Indian population. In all the colonies the number of whites is small, but their spending capacity is usually high. Legislatively, the term "British West Indies" suggests a unity which, in effect, does not exist. British Guiana, British Honduras, Trinidad, Jamaica, Barbados, the Bahamas and the Bermudas are all separate Colonies having separate governments, separate laws, and separate tariffs. Each of the two groups named the Leeward Islands and the Windward Islands has one governor, but all the larger islands which comprise these groups make their own laws and draw up their own Customs tariffs.

Notes and Comments.

Just prior to the outbreak of war the finances of the West Indies were in a very precarious position owing to the low level of prices of all agricultural commodities. Conditions had not been so bad since 1897, the year when a Royal Commission visited the West Indies to investigate the serious position into which these Colonies had fallen, due to the competition of bounty-fed beet sugar. Since the time of the Commission the price of cane sugar had risen slightly until the year 1913, and factory methods had been improved. Also planters had turned their attention to other classes of tropical produce and the West Indies were less dependent than they had been on sugar. But cocoa fell from 72s. per cwt. in 1913 to 58s. in 1914: sugar fell from 17s. to 12s. 3d., and the demand for and prices of other commodities declined in a similar way. Properties were being mortgaged, the stores were accumulating unsaleable stocks, and the banks were anticipating the carrying over of loans to the following year. Thus the position at the outbreak of war was a very serious one. But the advent of the war changed the financial aspect. Prices of products rose almost immediately, in the case of sugar to 28s. in 1915, to 43s. in 1916, and at the end of the war it was fetching 60s. per cwt. Prosperity followed, mortgages being liquidated and plantations changing hands at record prices.

But with the summer of 1920 came another crisis. Droughts in some of the islands and a slump in sugar and cocoa prices, followed by a restriction in banking facilities, brought about a complete change in the financial outlook, and since then trade has been stagnant.

The Canadian-West Indian Agreement.

In May, 1920, representatives from the Governments of all the British West Indian islands and of British Guiana and British Honduras met at Ottawa to confer with the Dominion Government on such subjects as cable communications, transport facilities, preferential tariffs, and trade relations generally. A similar conference had been held in 1912, when a preference tariff was introduced, relating, however, to only a few selected commodities. The new conference resulted in preferences being accorded to Canada, varying from 25 to 50 per cent., while the Canadian reciprocal preference is a uniform one of 50 per cent. Sugar from the British West Indies receives a preference varying from 46·08 to 96 cents per 100 lbs., dependent on the degree of polarization. The West Indian colonies have also agreed that preferences given to Canadian goods shall likewise be extended to the United Kingdom.

Jamaica and the Dutch Standard.

The colony of Jamaica, which was not a party to the first agreement, was the first to ratify the 1920 agreement. In that island and to a smaller degree throughout the sugar-growing colonies, disagreement has been strongly expressed with regard to the retention in the new agreement of the Dutch Colour Standard for classifying sugar for duty purposes. In order to protect Canadian refiners a prohibitive duty is imposed on grocery sugars and the colour test is used for this purpose. The objections to the use of the Dutch Standard are that it varies from year to year and that refining sugars near the border line of colour may occasionally be penalized through being too light. To meet this difficulty the Canadian Government have agreed to amend the Canadian Customs Tariff so that sugar above No. 16 Dutch Standard in colour when imported by a recognized sugar refiner for refining purposes only will not be subject to the extra duties.

Preferential Tariffs and American Competition.

In accordance with the terms of the Canadian-West Indian Agreement, the Tariffs of Trinidad, British Guiana, British Honduras, Grenada and St. Vincent have been revised, and the other colonies are expected to introduce new Customs Ordinances in the near future. In all the colonies named the preferential rate is 10 per cent., the general rate 20 per cent. in Trinidad and British Guiana and 15 per cent. in the others. This preference when added to the premium of 25 per cent. at which American exchange stands at the time of writing gives British exporters a very substantial advantage, which is likely to be increased later in the year when American wheat and cotton are going forward to the United Kingdom. In the case of Trinidad, American goods are subject to yet greater charges owing to the fact that import duties are assessed on their cost in American money. Thus goods invoiced at 100 dollars are subject to duty at 20 per cent. on 125 dollars (= 25 dollars) and apart from freight charges they cost the Trinidad importer 150 dollars as against 110 dollars, the cost of British goods invoiced at the same sum. The British exporter has, therefore, an apparent advantage of over 36 per cent., which is, however, offset by a slight difference in freight rates and a more important difference in the time which elapses between the order and delivery.

American competition has been very keen during recent years. The war period gave the American exporters a strong temporary advantage and the proximity of the West Indian Islands to the American coast gives them a permanent advantage. Americans, indeed, think of the West Indies as one of their natural markets, and, on account of the frequent and regular steamship services and of the careful attention which many American exporters give to the smallest orders, West Indian merchants are encouraged to think in the same way. The West Indian is naturally very conservative and, although this fact has been of some service to the British exporter in the past, the names of certain American goods have recently become household words and in these lines the British manufacturer will experience some difficulty in re-establishing himself. Owing to the advantage of geographical position, American goods reach their destination more quickly than British goods; this point should be borne in mind and every effort should be made to expedite delivery. The opinion is general that British manufacturers look upon the West Indies as being a small and unimportant market, useful at times when business is slack but negligible at other times. However true this may be, there is certainly business awaiting British firms who will make a few concessions at first in order to obtain a footing in the West Indian market and will then give the careful attention to their customers in the West Indies that they would give to those in the more important overseas markets.

Cuba's Sugar Problem.

A recent issue of *Facts about Sugar* devotes a leading article to the problem of disposing of the surplus supply of sugar in Cuba, which is worth summarizing. Our contemporary points out that the present difficulty that confronts Cuba is a direct heritage of the sugar buyers' stampede of last year when the magnet of high prices drew to the United States market a million tons of outside sugars that were not needed in America, but could have been used in the various quarters of the world whence they were drawn; the flooding of the market with these merely displaced a million tons of Cuban and domestic sugars that had to be carried over into the current year, and the result is there is still a big surplus that will have to be carried over into 1922, to the detriment of the new crop sugars shortly due on the market.

Notes and Comments.

It is of course true that Cuba's troubles are in the long run due to the war, which led the Allies to look to Cuba to supply them with unaccustomed quantities of sugar in place of the Continental beet, and so encouraged the extension of her production to a degree that has now become an embarrassment. Yet, but for the financial exhaustion resulting from the war, Europe might easily now have absorbed all Cuba's surplus. As it is, she is too impoverished to buy largely the sugar she would otherwise readily absorb.

Under the circumstances, the practical problem now placed before Cuba is whether it will be more advantageous to go on producing to the limit of her ability or whether it would be better to apply some limitation to production, for one season at least, in order to give an opportunity for the restoration of a more normal balance between supply and demand. This is assuming that lack of credits and other financial difficulties do not operate to restrict production to three or three and a quarter million tons without any concerted or official action.

But limitation by voluntary agreement has been shown as the result of many attempts to be unworkable; only legislative restriction, acting either in respect to the size of the crop or the length of the grinding season, would stand a chance of success. The latest plan, according to our contemporary, is to defer the opening of the grinding season until January 15th or February 1 and to prohibit new crop shipments till February 15 or March 1. The law, it is suggested, could be enforced by placing a prohibitive tax on sugar produced before a certain date. Supporters of the plan assert that it would have the effect of limiting the grinding season to the period when the cane gives the best yield and that, while reducing the total output, it would make it possible for the smaller crop to be produced at a lower relative cost. Meanwhile, longer opportunity would be afforded to find a market for the old crop surplus before the new crop comes into competition with it.

Cuba's Ultimate Stability.

But though the problem is not an easy one to solve, the position of Cuba in the long run is not one to inspire any fears for her ultimate rehabilitation. Her real wealth as represented by her productive capacity remains unexhausted. Her financial condition is at present in a very bad way; her banks are overloaded with depreciated assets consisting largely of mortgages on properties whose value to-day represents only a relatively small percentage of the sums originally loaned on them. But the opinion is expressed that if sufficient time and patience is shown Cuba by her creditors, they will in the end receive a very considerable percentage of the sums due to them. On the other hand, forced settlements at the present moment are yielding something like 15 cents only to the dollar.

Cuba is, however, too good a customer of the United States to be harshly treated. For the year ending June 30th last, she held fourth place in purchases from the United States, and in proportion to her population and total commerce she is by far the best customer the United States have. Statistics of sugar machinery exported from the States do not indicate the country of destination, but Cuba was known to have taken the larger part of the exports of the year in question, amounting to over 29 million dollars in value. In the opposite direction, Cuba's exports of sugar during the past year were valued at nearly \$420,400,000, of which over 80 per cent. went to the United States, while exports of leaf tobacco, copper, bananas and hides were very considerable. It is clear then that the recuperative power of this island is too great to allow more than a temporary eclipse of its general prosperity, and the only question is how best Cuba can tide over the interval so as to suffer the minimum dislocation of her normal trade.

Fifty Years Ago.

From the "Sugar Cane," October, 1871.

Several useful technical articles were published in this issue of our predecessor; and the first of these discussed the value of various chemicals that had been proposed as clarifying agents for cane juice. Tannin, which had been strongly recommended by EVANS, BASSET and other writers, had proved unsuccessful by reason (it was stated) of the necessity of employing none but copper vessels, and of the difficulty of obtaining the product in sufficient amount. Aluminium sulphate had been found to possess several advantages. On dissolving this salt in the juice in the proportion of 1 lb. to every 100 gallons, and following its addition with 10-12 ozs. of lime, it was said that the aluminium hydroxide thus formed combined with the colouring matters and precipitated a large amount of the organic non-sugars substances present. According to a curious method of clarifying cane juice, proposed by Mr. GARCIA, of Louisiana, a fatty acid was added to the limed juice to form an insoluble soap, which on rising to the surface carried along with it the suspended impurities, leaving the liquid below clear and limpid. This method of procedure was found to clarify the juice "exceedingly well," but to prove too costly in practice.

At the present day, writers on the use of decolorizing carbons emphasize that the great desideratum is to produce a preparation so cheap that it can be discarded after use without troubling about revivification. It is therefore very interesting to read in an article published by ÉMILE ROSSEAU 50 years ago in this number of the *Sugar Cane* a statement of this desirable possibility which read as follows: "It is necessary then to find a decolorizing char, which may easily be employed in fine powder, and of which the price will be lower than the cost of revivifying animal charcoal in grain; in order that, after using it once, it may be thrown away or applied to agricultural purposes" These are almost the same words as those quite recently used by a well-known American sugar technologist.¹

Lastly, in this issue there was reproduced an article giving the results of the careful chemical control of a beet factory at Groningen, Holland, in which a very full account of the possible sources of loss of sugar during manufacture was stated. It was by FISCHMAN, and was a very complete research judged in the light of the knowledge of the subject existing at that time. He had computed the loss of sugar in the exhausted slices, the diffusion waste waters, the press waste waters, the filter-press washings, the char-filter wash waters, and the condenser waters. These were found to amount to an average of 0.69 per cent. of the roots, which deducted from the total loss of 1.74 per cent. (found by deducting the sucrose in the first massecuite from that in the roots) left almost 1 per cent. This loss was believed to occur during diffusion; and FISCHMAN had endeavoured unsuccessfully to estimate its amount by collecting the CO₂ disengaged from the juice in the diffusion vessels. However, the loss in diffusion is now known to be small, less at any rate than 1 per cent. HERZFELD in 1905 placed it at 0.18 per cent., and attributed a certain loss to sucrose decomposition during heating, evaporation, and boiling.

¹ Compare Dr. HORNE, *Jl. Ind. Eng. Chem.*, 1920, 12, 1015.

The Jamaica Sugar Industry.

(From a Correspondent.)

There has been a great development of the Jamaica sugar industry in local and foreign publications during the past few years; but while the actual development represented by the new factories erected for the 1921 crop appears encouraging, the final return of sugar and rum produced from the crop just completed does not justify much optimism.

The Bernard Lodge Central of the Keeling-Lindo Co., parish of St. Catherine, was the first of the new centrals to be erected and took off its first crop of 8000 tons of sugar in 1920. The price of sugar ranging from £40 to £100 per ton during the middle of 1920 stimulated both the manufacturer and producer to make into sugar all available cane permissible, with a large planting in view for the 1921 crop, so that the sugar crop reached about 45,000 tons. Some of the planters preferred to keep in storage part of their products for higher prices when sugar was selling for £40 to £100 and rum 10 to 12 shillings per gallon, consequently part of the 1920 rum is still unsold and an appreciable loss of the possible profits on the sugar held was sustained.

The high prices paid for cane and the huge profits expected from the manufacture of sugar induced most manufacturers to spend their profits for improvements costing two to three times the pre-war figure; the banker to advance £20 to £25 per ton of estimated sugar output to any Company with land and a small capital for the erection of a sugar factory. The result of money being easily obtainable and the outlook for sugar bright was the establishment of four sugar factories in new districts and the replacements of five old sugar factories with larger buildings and new machinery.

The largest of these new factories erected for 1921 was the Gray's Inn Central Factory, Ltd., in the northside parish of St. Mary, owned principally by Sir JOHN PRINGLE. It is a 14-roller plant built by the MIRRELES WATSON Co., Ltd., with sufficient capacity to produce 10,000 tons of sugar per annum. Another banana and coconut section that has been invaded by sugar cane is the Plantain Garden River district in the parish of St. Thomas by the erection of a small 8-roller plant by Messrs. HENRIQUES BROS. of Kingston, the principal machinery being supplied by the MIRRELES WATSON Co., Ltd. and JOHN McNEIL & Co., Ltd. The mills are only 22 in. × 36 in. and the ultimate cane supply was expected to be sufficient to produce about 800 tons of sugar annually. Messrs. HENRIQUES BROS. are engineers and are owners of a large foundry and shop in Kingston.

HARRISON, a retired professor, owner of considerable property and cattle in the parish of St. Elizabeth, became enthusiastic over the sugar situation, the result being the erection of a small 11-roller mill and plant called Union by the Honolulu Iron Works Co. of Hawaii. The mills in this factory are also 22 in. × 36 in., the ultimate sugar capacity per annum being about the same as the Plantain Garden River plant. Nearer the mountains and about six miles from the Bernard Lodge Central in the parish of St. Catherine, a small factory called Bybrook was erected by LINDO, the capacity of the plant being only 15 to 20 tons of sugar per 24 hours.

Of the remodelled sugar factories in Jamaica, possibly Serge Island was the most modern and best equipped, all machinery now being operated by electricity instead of steam as was previously the case. This plant is in the parish of

St. Thomas, is principally owned by the Holgates, and known as the Serge Island Estates Ltd. Its rated capacity is about 40 tons of sugar per 24 hours. The owners were at a great advantage in having a dam in the Johnson river, about two miles from the site of the factory, giving a 60 ft. fall and consequently sufficient electrical power for their complete factory. Owing to the vanishing supply of wood fuel in Jamaica the electrification of sugar plants is becoming worthy of serious consideration especially when there are so many available waterfalls. Albion, a very old sugar estate belonging to the GRINAN family, was purchased by Messrs. DaCosta and Machado, remodelled and a new 22 in. \times 36 in. 11-roller milling plant installed, the idea being to purchase all cane the plant could grind in addition to that obtained from their 500 acres of cultivation. Nearly all of the above-mentioned factories are located some distance from the Jamaica Government railway line and are dependent upon carts, principally, for bringing their supply of cane to the factory. On the Chapelton branch of the railway Dr. A. GRINAN has erected a modern factory called Sevens with very attractive buildings for his employees. The old Sevens factory which was not on the railway line, was dismantled and part of the machinery used in the new factory. This plant, now an 11-roller mill, 24 in. \times 48 in., is equipped for and has the cane supply to make 2500 to 3000 tons of sugar per annum. This is one of the best locations in the island for a sugar factory as crop failures are very rare, the annual rainfall usually being quite sufficient to produce a good crop at times that other estates suffer for want of rain. On the main line of the Government railway to Montego Bay, the LINDO BROS. have established an 8-roller plant, the mills being 22 in. \times 36 in. This modern plant takes the place of the old Appleton factory which was widely known for its high-class rum. Most of the machinery was removed from the old Grange Lane factory which was replaced by the large Bernard Lodge factory. Another small plant known as Freeman's Hall was erected by the Hendersons near Allsides P.O.

Mr. J. H. BLAKESLEY, from Scotland, was employed as Consulting Engineer for the Government to select or advise the site for the Central Factory to be established in St. Thomas; however, at the time of writing the general opinion is that it is not wise to risk such a large sum of taxpayers' money in erecting a sugar factory and the probability of such a factory ever being established is doubtful.

The sugar season of 1920 was Jamaica's most prosperous period and at that time there was a bright prospective future for Jamaica in 1921 with her new factories and the increased cane cultivation. Unfortunately a severe drought was experienced on most of the plantations about August and continued long enough to reduce the production to about 25 per cent. of the normal on some plantations; and, added to this misfortune for the 1921 crop, was the heavy rain during the harvesting season. It became necessary for nearly all the factories to stop grinding for two to three weeks and shortly after resuming operations the yield of sugar per ton of cane was so poor that it did not pay to operate at the current price of sugar. The high freight rates charged by the Government Railway, the drop in the quality of the cane after the heavy rains, coupled with the dullness of the sugar market made it necessary for some of the planters to leave part of their 1921 cane crop in the field.

The total sugar production in the island will not reach 38,000 tons for the 1921 crop and the price offered in July ranged from twelve to fifteen pounds sterling per ton. The cane crop having been grown with high priced labour, and all factory repairs and installations made at a cost that could only be justified with

The Jamaica Sugar Industry.

sugar at thirty to forty pounds sterling, naturally the planter preferred to store his sugar and rum to wait for prices that would justify his expenditures in producing the crop. The result was that the greater portion of the 1921 sugar and rum crop was stored with a very dull market for either, and a great number of the manufacturers and planters were without sufficient funds to carry on preparations for the 1922 crop as their advances from the banks had reached their limit.

The Jamaica Government, realizing the serious condition in which the labourers as well as the planters and manufacturers would be placed should preparations for the 1922 crop cease, immediately put a bill through the Legislature to afford a temporary aid to the sugar industry by raising a loan of £400,000 for the purpose of carrying on those estates and cane farms applying for help. The Government will borrow the money from the banks at 7 per cent. interest and let the applicants have it at 8 per cent., the applicant giving the Government a first mortgage on the property. Up to the present there have been 14 applicants, involving 28 properties, which have applied for aid; this means that if all applicants are granted aid each estate will receive approximately £14,000. The labourers dependent upon the applicants for the loan are estimated at about 40,000.

Not one of the new factories erected for the 1921 crop made 50 per cent. of the sugar which was estimated at the time the machinery was purchased, consequently the ability of these factories to ride the wave of financial depression with small sugar crops and a poor market is problematical.

Sugar cane being a much more expensive crop to grow than either bananas or coconuts, the present crisis may stifle any increase in the future sugar production in districts where bananas or coconuts may be grown. There are only a few favoured districts sufficiently large and well located to economically establish and operate a factory capable of grinding 1000 tons of cane per day of 24 hours; transportation, labour, and fuel supply are the present handicaps to the operation of larger factories economically.

Anyone may estimate that if only a portion of Jamaica's available sugar land was put into cane cultivation, she would be capable of producing from 100,000 to 200,000 tons of sugar; but, if the cause of the temporary increase in production and the general requirements necessary for a steady growth are taken into consideration, it would be more than optimistic to place her ultimate annual production beyond 75,000 tons.

A proposal to undertake the conversion of rum into industrial alcohol in Jamaica has been referred to a committee of planters. It is intended to convert the rum into rectified spirits for shipment to Canada and elsewhere, using plant which would be installed in a factory on the outskirts of Kingston.

A company has been incorporated in London under the style of Producer Gas Plants, Ltd., for developing the Parker portable producer patents, relating to the principle of substituting producer gas in place of petrol, alcohol, or other liquid fuel for internal combustion engines driving motor cars, tractors, etc. A producer weighing 400 lbs. for a 40 H.P. unit has been successfully evolved. In the case of a 3-ton lorry carrying this portable producer plant, 2.6 lbs. of coke per car-mile is the average consumption under a full load, that is, 9s. per 100 miles with coke at £4 per ton. In the case of a similar vehicle covering the same distance, the fuel cost, using petrol at 2s. 6d. per gallon, would be £2 2s. 6d. Therefore (it is concluded in one of the reports published in the prospectus) the saving would be 78 per cent. of the fuel cost, equal to petrol at less than 7d. per gallon. A producer of a type suitable for consuming charcoal for use in tropical countries has been designed. Mr. E. S. SHARPELL-SMITH, F.C.S., and Mr. H. Wm. BAMBER, M.I.Mech.E., are Chairman and Consulting Engineer respectively of this new venture.

The Report of the Indian Sugar Committee.

II.—AGRICULTURAL.

As regards the growth and cultivation of the sugar cane in India, the Committee sets forth in some detail the observations made during its somewhat hurried and cursory visits to the various Provinces, and the conclusions it has arrived at as to possible improvements. For the convenience of our readers, and to make this part of the Report more intelligible, we have prepared a map giving the relative distribution of cane in the different Provinces, and have also subdivided the country into large blocks having some marked characteristic in common.

(1) The main north Indian tract, comprising the United Provinces, the Punjab and Bihar, with 2,000,000 acres of cane cultivation and three-quarters of that in India as a whole. This area extends in a south-easterly direction along the base of the Himalayas, from the Punjab where there is frost every year to Bihar where the climate is sub-tropical, with a distinct element of a purely tropical character. Excepting near the mountains, sugar cane needs irrigation in this tract, and its extent will therefore mainly depend on the facilities for this. The air is very dry, especially when the canes are germinating, and the growing period is very short, being followed and checked by a marked cold weather. The soil is alluvial and forms the upper, main portions of the Indus and Ganges basins. It is the natural home of the indigenous Indian canes which become thicker and larger from the Punjab to Bihar.

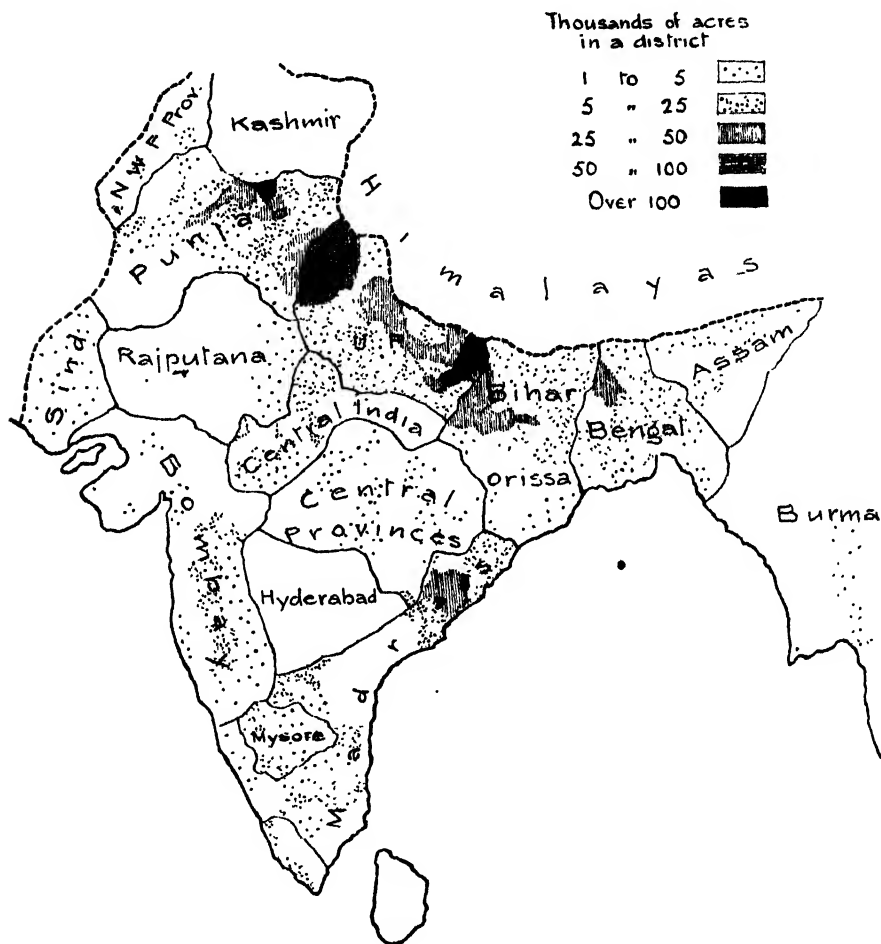
(2) Bengal, which extends further south than Bihar, has the tropical element more pronounced, and the air is generally moister. It consists of the lower basins of the Ganges and the Brahmaputra and of the great river formed by the union of the two. Much of it is flooded during the rains. The area under sugar cane is considerably less than in former years, owing to the great extension of jute growing. Thick tropical canes, intermediate forms, and indigenous varieties jostle one another throughout its length and breadth.

(3) The North-west Frontier Province, Assam and Burma, although widely separated geographically, have the common characters of comparatively sparse population and inconsiderable areas under cane, but also the capacity of growing excellent tropical varieties. They appear to owe this character rather to appreciable moisture in the air than to a truly tropical climate, but differ greatly among themselves in range of temperature. The soil is alluvial and has been formed by the Indus, Brahmaputra, and Irrawaddy rivers respectively. As will be seen in the sequel, each of them has the elements of possible factory installation. Irrigation is not needed in Assam and Burma.

(4) Bombay with Sind occupies a very long strip of land bordering the western side of India, between north latitudes 16° and 28°. While Sind is in the lower part of the Indus valley alluvium, Bombay proper boasts of an excellent volcanic soil originating, in the main, from the decomposition of underlying trap rock. Here some of the best canes in India are to be found, and very heavy yields are obtained, but this is in large part due to the very heavy doses of manure which it is the local custom to give the cane fields. The area under cane in Bombay, although mainly in the tropics, is comparatively small (102,000 acres), and is entirely dependent on irrigation.

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(5) Madras and Mysore.—This area is purely tropical and covers the lower half of the Peninsula, with a long streamer up the east coast nearly to Calcutta. It includes the deltas of three great rivers, but these are almost entirely devoted to rice cultivation. While in every respect suited to the growth of thick tropical canes, the areas under the crop are small and very scattered, totalling only about 150,000 acres.



SUGAR CANE MAP OF INDIA

INDICATING THE ACREAGE UNDER CANE IN EACH DISTRICT.

THE MAIN DETAILS OF THIS MAP ARE TAKEN FROM ONE PUBLISHED BY THE SUGAR COMMITTEE, AND IT REPRESENTS FAIRLY ACCURATELY THE RANGE OF DISTRIBUTION OF THIS CROP. AS, HOWEVER, THE DISTRICTS ARE NOT OF EQUAL SIZE, THE SHADING DOES NOT ALWAYS AGREE WITH THE CONCENTRATION OF CANE GROWING. THE DISTRICTS IN SOUTH INDIA ARE, FOR INSTANCE, LARGER THAN IN THE NORTH, AND THE MAP THEREFORE SUGGESTS MORE CANE IN THIS PART OF INDIA THAN THERE REALLY IS.

Considering these five regions, there appears to be something topsy-turvy in the growth of the sugar cane in India. Its greatest extent is just where the student would say that the climate was most unsuitable. The most suitable climates are to be found in the extreme north and south, but in each case there is some limiting factor which reduces the area actually under cane to very small proportions. The area cultivated under the Himalayas, the natural home of the thin, indigenous kinds, from the Punjab to Bengal, is 2,217,000 acres, while that in the rest of India where thick tropical canes can be grown is 359,000 acres, nearly 100,000 acres less than in the Punjab where frost occurs every year and the thinnest and most primitive canes in the world are grown.

Let us now proceed to consider the mass of observations and deductions made by the Committee on the agriculture of the cane during their tour through the different provinces. These cover 165 folio pages and contain an enormous mass of detail; it will thus only be possible to deal with each very briefly, and we have followed the Committee in treating more fully of those parts where the importance of the crop or the prospect of extension is greatest.

The United Provinces contain more than half the area under cane in India, but the climate, already briefly alluded to in Paper I,¹ renders the cane problem of much complexity. Most of it is under irrigation, but the canals were designed for the intermittent use of such crops as wheat, which only requires water two or three times during growth. The canal systems are considered in some detail as regards the possibility of extending the area under sugar cane, and a map is inserted giving their arrangement. There does not appear to be much chance of expansion under the old canal systems, but there may be some under the Ganges canal where new head works are being constructed, while the new Sarda system now sanctioned may add another 100,000 acres under cane. Wells are an important accessory to canal irrigation in the tract, and the Committee recommends a careful fostering of this source of supply under the charge of a full time agricultural engineering officer, whose work should be confined to well boring and pumping installations. For such work to be successfully carried out, it is important that it should be concentrated on special, selected areas, for ease in management and for propaganda purposes. The department should also investigate the possibility of obtaining power from the rivers so that tube wells may be worked electrically. The concurrent importance of efficient drainage is also urged, as most of the diseases in Indian cane fields are primarily due to waterlogging.

The Committee is strongly of opinion that improved methods of agriculture should go hand in hand with the introduction of better kinds, and expresses its belief in no uncertain manner that progress is likely to be more rapid in the former than in the latter direction. The work being done in testing Coimbatore crosses and imported tropical canes should be continued and expanded and a hill station should be opened for the supply of sets after the Java plan, this station also serving for Bihar. This is one of the many directions in which the Committee has drawn inspiration from its visit to Java, but we are led to wonder whether there would be any need for this innovation and, if there were, whether it would be possible to carry it out in this tract. Change of seed is well known by the Indian cultivator to be beneficial, but we doubt the advantage of trying the hills for this supply in north India. If India is to be self supporting as regards its supply of sugar, the Committee considers it essential that new thick and medium canes should be grown and much better cultivation methods adopted. Such introduction of better canes has already been demonstrated on the Shahjahanpur Cane Research Station, where

¹ *I.S.J.*, 1921, p. 491.

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suitable supplies of water and manure are available. The Committee further finds that the best system of cultivation is the Java method of trenching, although it is recognized that this will require a large and efficient labour supply.

Besides the larger proposals of a great Research Institute and experimental factory, which are both to be erected in this Province, the work being done at present should be greatly extended and made to apply to the whole area; the Shahjahanpur farm should be extended to 200 acres, and two new research stations should be opened at opposite ends of the Provinces, namely in the Gorakhpur and Meerut divisions, where cane growing is most concentrated, in each case with a 200-acre farm. All research work, whether chemical or botanical, should be placed under one whole time officer, and this development should not await the formation of the Research Institute but be carried out as soon as possible. Efficient bands of demonstrators should be trained at the three research stations for propaganda work on improved agricultural methods and varieties in all the chief sugar tracts of the United Provinces.

Bihar (267,000 acres under cane) is next dealt with, presumably as it is at present the chief centre in India of the manufacture of white sugar direct from the cane. This important industry lies in north Bihar near the Himalayas and the canes are usually grown without irrigation. It is a somewhat anomalous fact that very little cane research work appears to have been done by the local Government, and much preliminary investigation is thus needed, even before demonstration parties can be profitably formed. The Committee finds that the Sone canal area, south of the Ganges, is the most promising field for extension, but the drainage is bad, and until this is attended to the problem is insoluble. It suggests that a drainage survey should be immediately started both here and in the flooded areas north of the river. Cultivation is in need of radical reform; a prolonged fallow in the summer or a green manuring crop before cane is insisted on, a fodder crop should be introduced into the local rotation for the feeding of the small cattle and thus fitting them for the severe work of the cane cultivation and harvest, selection of sets, planting in rows and less thickly, improved after-cultivation and the use of oil cake as manure are also suggested as much needed improvements.

Most of the cane used by the planters in north Bihar is grown by the ryots, and consists of the local indigenous varieties, some of which are above the average. The immediate need of the planters, who cultivate some of the land, is a series of improved varieties, capable of responding to intensive cultivation such as is not applicable to the indigenous varieties as a whole. For this and other purposes the foundation of a properly located research station is considered urgent. This matter has been before the local Government for quite a number of years and various sites have been selected in turn; the final decision is in favour of one in Saran district which although an important sugar tract is remote from the area occupied by the planters. The Committee points this out and, while suggesting that the Saran station may be of use locally, considers that a new and bigger one should be installed, perhaps in the neighbourhood of Pusa. The interrupted work on the classification of the local cane varieties should be taken up again and completed, and the propagation of *Hemju*, the kind chiefly grown, and other superior native kinds should be made along pure lines, and distributed. Dr. Barber's crosses and indigenous varieties from other provinces should be tested under ryot's conditions and special efforts made to obtain an early maturing sort. But until the research station has obtained appreciable results a special demonstration staff should be postponed.

The Punjab, where 438,000 acres of cane are grown and there appears to be the likelihood of an extension, seems to interest the Committee less than the United Provinces and Bihar. The province shows the least development in the industry, as regards the kind of cane grown, the yield obtained and the cost of cultivation. The climate is extreme, frost in December and the very high temperature of 116° F in summer. Most of the cane is grown under the great irrigation projects which have converted deserts only occupied by nomadic pastoral tribes into rich oases, so that it should not be so difficult to obtain large blocks for sugar cane concentration if this were considered necessary. But the climatic conditions are unfavourable, and the Committee considers that the short period of the rains and extremes of temperature will remain a handicap on cane growing as compared with the less tropical wheat and cotton. Their recommendations are similar to those for the United Provinces but on a much smaller scale. A whole time cane research officer should be appointed but the time is not ripe for a demonstration staff. The work of testing superior varieties from other provinces, exotics and crosses from Coimbatore, should be continued and extended. It is worth recording that some of the Coimbatore crosses were obtained from tropical canes and the wild *Saccharum spontaneum*, and that the local *Katha* cane, which is the main variety in this part of India, is apparently nearer to the wild *Saccharum* than any other cane in India. Frost resistance will always be a dominating element in successful introductions, and this is constantly studied in comparing the suitability of new kinds under trial.

Bengal need not detain us long. The Committee does not consider that there is any prospect of extension and this fact, together with the intrinsic importance of the industry, does not justify either a special research station or a whole time sugar cane officer. It records its opinion that attempts at improving the cultivation should be confined to regions above flood level, and suggests that the interesting classification of the varieties, nowhere more mixed than in Bengal, should be resumed and brought to a conclusion. There are 222,660 acres of cane.

The North West Frontier Province has a small area of cane (32,000 acres) in the Peshawar valley which is extremely interesting. Although the extremes of temperature are even greater than in the Punjab (30°F to 120°F in the shade) it is not difficult to grow good tropical canes, and this the Committee considers as due to the comparative dampness of the air. As this area is further north than any other in India we must ascribe the failure to grow thick canes in the main north Indian tract to the dryness of the air rather than to the other climatic factors already enumerated. The cultivation in the Peshawar valley is however of a much higher order than in the United Provinces. The Committee draw attention to the excellence of the cultivation, the digging in of a leguminous crop and the practice of clamping or windrowing the canes through the cold weather. Recent study of this practice by the Pusa chemical section has shown that comparatively little change takes place in the juice of the canes during the first two or three months in the ground, which should lengthen the season for factory work, although the extra cost does not seem to have been given due weight. Added to this, sugar beet grows very well and the suggestion has been made that it might be possible to start a central factory dealing with these two crops. The great need is for an early ripening cane of good quality. Owing to the smallness of the area and the improbability of greatly extending it, the Committee does not recommend the appointment of a research officer or the opening of a research station, but suggests that a chemist should be employed who could carry on the work commenced at Pusa.

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Assam, although at present very little cane is grown, presents very distinct possibilities. The climate is devoid of extremes and the air remains moist throughout the year. An experiment on a large scale has been carried out in recent years of putting waste grass land under cane, and although open to many serious criticisms has undoubtedly produced some useful results. At present there seems little likelihood of improving the scattered ryot's cultivation and the only apparent line of progress lies in the direction of central factories controlling their own lands, and planting good, heavy yielding canes, which appear to thrive and mature well without irrigation. For this purpose there are large areas of unoccupied land ready to be taken up but, to avoid the mistakes of the past, the Committee suggests the appointment of a committee of three whose main duty would be to survey the available lands and select suitable localities for pioneer factories. One or at most two research stations should be opened when the Research Institute has been founded, but until then the present work at Jorhat should be continued. Many problems await solution in Assam, and these are of a totally different character from those mentioned in the other provinces already referred to.

Burma is mainly tropical, but in many respects resembles the more northerly Assam. The air is moist and irrigation is largely unnecessary. The old alluvial soil of the Irrawaddy at present taken up with rice growing seems unsuited to the growth of the sugar cane, but there are large areas of suitable soil in other parts, where abundant rainfall and the absence of extremes of climate favour the crop. The amount of cane grown at present is insignificant (16,000 acres) and a similar committee of three is suggested to that for Assam to make surveys of the waste lands and locate suitable sites for central factories and research stations. The Committee suggests three such localities, namely the Bilin, Pyinmana and Namyia districts, but considers that the Mon canal region, for which high hopes were at one time held as regards sugar factories, should be definitely left out of further consideration. On the creation of the central Research Institute for India the cane work should be concentrated under one officer. Important lines of study for larger estates would be the best commercial rotation and the discovery of a good, early maturing cane. There are also good prospects of improving the small growers' practice, and pure lines of the *Pyinmana Red* and *Toungoo Yellow* canes should be propagated and distributed. For popularizing and extending cane cultivation in Burma the Committee suggests the reduction of the present rate of assessment on cane lands and especially low rates for ratoons.

Madras.—The Committee "frankly confesses to a feeling of disappointment that in the only major province in India which lies entirely within the tropics the prospect of any appreciable extension of cane cultivation cannot be regarded as at all hopeful . . . the main reason given for the preference of rice growing is the absolute certainty of the crop and the ease of growing and marketing it." Rice is the main obstacle, and the cane cultivation always under irrigation lies in scattered areas (altogether 109,000 acres). The only line for material expansion is that of a factory industry growing its own cane on leased land, and Ganjam and Vizagapatam are the most likely districts where this may be accomplished.

Work on the introduction and acclimatization of exotics should be continued and extended to these and the Bellary districts. The reduction of the number of sets used in planting is of special urgency and the possibility of introducing the Manjri method of cultivation should be tested where there is a sufficient concentration of cane: the experiment in the wrapping and propping of canes at Samalkota should be continued to a definite conclusion.

The Committee makes a number of suggestions regarding the future research work in Madras, the details of which need not be given here. The main substance appears to be that the officer in charge of the extended Cane-breeding Station at Coimbatore should also be in charge of research for the southern portion of the Presidency, that a further research station should be opened in the neighbourhood of Chittoor for the study of cane matters in the central districts, that the Samalkota farm should be increased to 200 acres and deal exclusively with the Godavari delta, and lastly that a fourth research station should be opened north of Anakapalle to deal with the Vizagapatam and Ganjam districts. This seems to us to be a rather large programme for a tract containing little over 100,000 acres of sugar cane, and we doubt the advisability of saddling the cane-breeding expert for all India with the charge of a local tract where the cane areas are extremely scattered and much time would be taken up in visiting them and acquiring a first hand knowledge of their somewhat diverse conditions. But we may return to this subject when we come to consider the general scheme proposed for research over the whole of India, in which Coimbatore is vitally concerned.

Bombay.—The chapter on Bombay has two sections, one on Sind and the other on Bombay proper. This is justified, as there is nothing in common between the two beyond the necessity in each case for irrigation, and that any extension in the industry is dependent in the first instance on the exploiting of irrigation schemes recently completed or projected. To make the range of these clear irrigation maps are given both of Sind and Bombay. The Committee finds that there is no future for the cane industry in Sind unless and until the Sukkur barrage on the Indus is completed, and with this we may rest content. In Bombay the chief growing areas are in the Deccan, the high land at some distance from the coast where the watershed has been crossed and the rivers flow in an easterly direction across India; and the tract irrigated from these rivers offers the brightest prospects of extension in peninsular India, in that it is not considered improbable that in the near future 150,000 acres of cane may be added. This will be a substantial increase on the existing area in the province, namely 102,000 acres.

Waterlogging is already a serious problem on some of the canals and is at any rate partly due to seepage from them and their distributories. The question of lining the canals should be investigated and, in view of the heavy expense, it should be borne in mind that these Deccan canals were placed in a tract subject to acute and recurring famines, and were put down as protective rather than productive works. Considerable difficulty is experienced in obtaining large blocks of land for intensive irrigation and concentration of cane cultivation for central factories, and various forms of legislative action have been proposed from time to time to overcome this. The Committee is against the compulsory acquisition of land for such purposes: it further prefers not to express an opinion on the question of the re-distribution of agricultural holdings for carrying out drainage schemes, but is prepared to support compulsory acquisition of land that has gone out of cultivation through waterlogging and has been reclaimed at Government expense.

The main problem in agricultural improvement in Bombay is a reduction in the cost of cultivation, which is greater than anywhere else in India. Considerable progress has been made towards this in the experimental cane cultivation on the Manjri farm and the Committee presses for the active promotion of similar methods throughout the Deccan. For this purpose a special demonstration staff of two parties should be created and trained at once at Manjri, one for the

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Godavari and Pravara and one for the Niri and Muthi canals : and similar action should be taken as new canals are opened in the future. Experiments should be continued in order to discover new thick canes to supplement the *Pundia* variety, or in case of necessity to replace it, and the Cane-breeding Station at Coimbatore should co-operate in this work. Pure line sets of improved varieties should be propagated at Manjri and the classification of the indigenous canes of the province should be completed. The present high yields in the fields and the possibility of establishing a factory industry in the Deccan justify the creation of a whole time officer for cane research in Bombay, and the Committee takes the unusual course of recommending that Professor KNIGHT, whose work at Manjri they evidently appreciate, should be selected for the post. Manjri farm should be extended to 200 acres and subsidiary farms of 40-50 acres should be opened in Guzerat in the north and the Konkan on the coast.

Mysore, Hyderabad and the *Central Provinces* are tracts which, however interesting locally, have little influence upon the cane industry of India at large, and we cannot deal with them satisfactorily without going into more detail than is justified in the present article. We pass on to the concluding chapter of the agricultural section of the report, in which the Committee makes general recommendations as the result of its survey in the different provinces. To avoid unnecessary detail, we have collected some of the points in the summary of their conclusions placed at the end of the chapter.

The provision of a cheap supply of nitrogenous fertilizer is the most insistent problem in Indian agriculture. Before the war much oil cake was used for this purpose in the cane cultivation of a few advanced tracts, but the cost of this material has risen so greatly that it exceeds (as a source of nitrogen) that of the ammonium sulphate being produced in increasing quantities as a by-product in the Indian coal fields. This leaves out of consideration the greater humus value of the cake and its more extended action. Experiments should be pushed on with the view of increasing the amount of oil cake available and the question of the transport of the oil should be investigated by the Department of Industries. Meantime the possibility of utilizing power from hydro-electric schemes for the artificial production of such substances as cyanamide should also be worked out.

Deep ploughing is the first essential of improved cane cultivation, although the native plough (which does not turn the sod and is really a cultivator) is the best implement that the cattle are able to draw. A first step would therefore be to relieve the cattle of as much other work as possible. The use of power plants for crushing cane, threshing grain and pumping water would enable improved ploughs to be introduced and adopted. Cultivation by mechanical means can only be carried out on large estates. Steam tackle has been employed in various directions and the experiments carried out at Pusa show that this form of power can be used successfully and economically. Motor tractors could be used on the smaller estates. In any case of such mechanical preparation of the land, care should be taken that all subsequent operations could be carried out in like manner or by bullocks between the rows.

The Committee records its opinion that the testing of varieties should not be done on plots less than one tenth of an acre in extent and that chemical tests should be abandoned on all farms which cannot furnish the necessary equipment or efficient chemical control. This advice is quite sound: the tenth acre plot has been largely in use for many years in India, and although many farms have not been properly equipped as regards the chemical testing of varieties, much valuable work has been done in the past with the available resources. It thus

falls to the Committee's lot to supply the facilities that they demand, and this they do in their general proposals regarding cane research. The most important work of the agricultural department in India is the demonstration of improved agricultural methods and the spread of better implements: demonstration work should be extended everywhere for general propaganda, the staff being trained at research stations before commencing their work. The Committee records its opinion that demonstrations should only be made on the cultivators' own fields. The importance of agricultural engineering should be recognised by the incorporation of engineers in the regular agricultural service. A special demonstration staff should be created for the inspection and repair of all machinery issued or recommended, and subsidiary arrangements for carrying out minor repairs would follow in the natural course of events.

The indigenous canes of north India are remarkable for freedom from disease. As no remedy has been found for the more important diseases of cane, these are best countered by control measures, such as the introduction of new varieties, careful set selection and cultivation, and efficient drainage. The study of diseases can be reasonably left to the Imperial Mycological Department at Pusa, but the staff there should be strengthened for the study of insect pests by the addition of a special officer for the study of cane pests throughout India. The water requirements of the cane should be investigated on all agricultural stations working on cane, and the opening of the proposed research station in the Punjab for dealing with the water requirements of all crops should be expedited. The possibility of meeting the cost of lining the canals, for the prevention of seepage and water-logging, by raising the water rates in such areas, should be considered.

Lack of capital is one of the main obstacles to the proper cultivation of cane, and outside factory areas co-operation must contribute to remove this. The co-operative credit societies and depots for the sale of gur and the supply of oil-cake manures on the Deccan canals in Bombay furnish an object lesson both of the possibilities and the difficulties of this branch of work.

C. A. B.

Formulæ for Mill Extraction.

By P. H. PARR.

Having been in several countries and on other than sugar work for several years, it is only recently that my attention has been called to the article on the above subject written by Mr. NOEL DEERR, and published in the *International Sugar Journal* for September, 1917, but although that is now several years ago, I think I ought, as the writer of the original article in the *Engineer*, to make a few remarks in reply.¹

Mr. DEERR, after stating that I had developed certain methods for calculating mill extraction, goes on to say that "a complete algebraical solution of the different systems of maceration may be useful." The natural inference is that my solution was incomplete, and that Mr. DEERR has given a full analysis, but so far from this being the case, the facts are that my formulæ solve the problem completely whilst Mr. Deerr's do not—for they depend on the somewhat unusual assumption that the bagasse from each and every mill in the train has the same fibre content, and cannot be applied at all except with this proviso—and they are not even algebraically correct on the assumption made.

¹ Incidentally, it may be permissible to point out that Mr. DEERR erroneously gave my name as *Pharr* instead of *Parr*, the way that it was correctly printed in the *Engineer*.

Formulae for Mill Extraction.

I will first consider Mr. Deerr's expressions, and then give the full analysis by which my own formulae were obtained; this latter has never before been published, but in view of the importance of the question to designers and others, it appears to be desirable to place the analysis on public record.

Turning now to Mr. Deerr's expressions, let us simplify them a little, which we can easily do by writing $w = kf(1 - m) \div m$, which is equivalent to saying that k is the ratio of the maceration water to the residual juice in the bagasse, f being the fibre in the cane and m that in the bagasse, while w is the ratio of the maceration water to the cane, as used by Mr. DEERR.

With this value for w , the expression $r = \frac{wm}{f + wm - fm}$ readily reduces to $r = \frac{k}{1 + k}$ and $1 - r = \frac{1}{1 + k}$, and then the expression (on page 403 of the 1917.)

$$\frac{(1 - r)^n}{1 - r(1 - r)^{n-1}} \text{ reduces to } \frac{1}{(1 + k)^n - k}.$$

Now this is given as the amount of normal juice left in the bagasse after n wet crushings (or with a train of $n + 1$ mills), per unit of normal juice in the first dry bagasse, and this is the same thing as B_{n+1} / B_1 , where B_{n+1} is the Brix of the residual juice in the final bagasse and B_1 that of the normal juice; the reciprocal of this, or B_1 / B_{n+1} is my "Brix Ratio" R_{n+1} , and therefore we have, according to Mr. DEERR,

$$R_{n+1} = B_1 / B_{n+1} = (1 + k)^n - k.$$

Now, any accurate formula for the extraction with n wet crushings must hold equally well when $n = 1$, that is, for the case of two mills only with simple maceration on the single intermediate carrier, which is what the general case of compound maceration reduces to for this case, and the result given must then agree with the known simple expression for single simple maceration, which is that $1 - r$, or $1 / (1 + k)$ normal juice is left in the bagasse, as stated by Mr. DEERR at the top of page 402; this is equivalent to $R_2 = B_2 / B_1 = 1 + k$. We then notice that for $n = 1$, Mr. Deerr's compound maceration formula gives $R_2 = B_2 / B_1 = 1 + k - k = 1$, or that the whole of the juice remains in the bagasse—in other words, that there is no extraction due to the simple maceration, which is in contradiction to the known result $R_2 = 1 + k$. Therefore it is probable that there is something wrong with Mr. Deerr's formula.

I may here mention that for Mr. Deerr's special case, where all the bagasse has the same fibre content, my formulae give

$$R_{n+1} = 1 + k + k^2 + \dots + k^n \\ = (k^{n+1} - 1) / (k - 1), \text{ or } n + 1 \text{ if } k = 1,$$

against Mr. Deerr's $R_{n+1} = (1 + k)^n - k$.

It is also to be noticed that the expression $(1 - r)^2 + r(1 - r)^2 + \dots + r^n - r^n(1 - r)^n(1 + r)$ given by Mr. DEERR for the amount of residual juice in the bagasse after n mixing operations is one which continually increases with n —that is to say, that when starting up the mills, the bagasse gradually becomes richer and richer in sugar as the maceration becomes gradually effective, which is not reasonable.

The fact appears to be that the method of writing out the successive extractions *ab initio*, finding the general form, and then summing to infinity, is not easy even for three mills with two wet crushing units only, whilst for a train of four or six mills it is a most formidable task, and while in the absence of Mr. Deerr's complete analysis it is not possible to be certain, it would appear that he had made a slip somewhere; we may also notice that in his discussion of two wet crushing units, he makes no mention of the juice passing away to the factory during the mixing operations.

The values given for R_{n+1} by Mr. Deerr's formula and by my own, for $k = 1$ and various values of n (number of wet crushing units) are as follow:—

n	DEERR.	PARR.	n	DEERR.	PARR.
1	1	2	4	15	5
2	3	3	5	31	6
3	7	4			

from which it will be seen that the Deerr formula gives an extraction which increases with the number of mills much more rapidly than is shown by my own formula. For two mills ($n = 1$), the Deerr formula gives zero extraction from the maceration whilst mine gives the correct 50 per cent. with $k = 1$. For three mills the Deerr formula happens to give the same result as mine, while for a greater number of mills it gives a greater extraction. For instance, with 10 per cent. fibre in the cane, 50 per cent. fibre in all the bagasse, and water 10 per cent. on the cane, we have $k = 1$, and for four mills the Deerr formula gives an extraction of 98.41 per cent., whilst mine gives 97.22 per cent. only, or 1.19 per cent. less. Also, if the bagasse from the set of mills had fibre contents of 35, 40, 45, and 50 per cent., which is more like what it would be in practice than is 50 per cent. throughout, my formula gives an extraction of only 96.30 per cent., or 0.92 per cent. less still, while the Deerr formula is not applicable at all to this case. With modern heavy maceration and high extraction, these differences of 1 or 2 per cent. are quite considerable, and when actual mill extractions are being compared with the theoretical limits, Mr. Deerr's formula would show the mills to be working with considerable less efficiency than would mine, which I have reason to be correct.

I will now give the complete mathematical analysis on which my formulæ are based.

Let J_0 be the weight of juice entering the first mill—most conveniently taken as pounds per 100 lbs. of cane— J_1 the weight of juice extracted, and J_2 the weight of the residual juice left in the bagasse, all with a Brix of B_1 (expressed decimally). Similarly, let J_3 and J_4 be the weights of the extracted and residual juice for the second mill, with a Brix of B_2 , and, in general, the Brix of the juice dealt with by the n th* mill will be B_n , the weight of juice extracted will be J_{2n-1} , and the weight of residual juice will be J_{2n} . Let the "Brix ratio" $R_n = B_1 / B_n$, and then the total solids entering the first mill will evidently be $J_0 B_1$, the total solids in the juice remaining in the bagasse after the final n th mill will be $J_{2n} B_n = J_{2n} B_1 / R_n$, and the extraction will be $E_n = \left[1 - \frac{J_{2n}}{J_0 B_n} \right]$

Now considering a train of mills with compound saturation, the juice entering the second mill will be the residue from the first mill, plus the extraction of the third mill, or $J_2 + J_3$, and the total solids in this juice will be $J_2 B_1 + J_3 B_2$, giving a Brix at the second mill of $B_2 = \frac{J_2 B_1 + J_3 B_2}{J_2 + J_3}$. Similarly the juice entering the n th mill will be the residue J_{2n-2} at a Brix of B_{n-1} from the $n-1$ th mill, plus the extraction J_{2n+1} at a Brix of B_{n+1} from the $n+1$ th mill, giving a Brix at the n th mill of $B_n = \frac{J_{2n-2} B_{n-1} + J_{2n+1} B_{n+1}}{J_{2n-2} + J_{2n+1}}$

Next considering, say, the second mill, the total juice entering is equal to the total juice leaving, and the same applies to the total solids, so that

$$J_2 + J_3 = J_4 + J_5$$

$$J_2 B_1 + J_3 B_2 = J_4 B_2 + J_5 B_3$$

Then on taking the value of $J_3 = J_2 + J_4 - J_5$ from the first of these equations, and inserting it into the second, we obtain $J_2 B_1 - (J_2 + J_4) B_2 + J_5 B_3 = 0$

* Note that for the remainder of this article, n is the number of the mill, the dry-crushing unit being $n-1$.

Formulae for Mill Extraction.

Similarly for the third mill, adding 1 to the suffixes of the B's and 2 to the suffixes of the J's, we obtain $J_4 B_2 - (J_4 + J_7) B_3 + J_7 B_4 = 0$, and following the same reasoning there results the series of equations

$$\begin{aligned} J_2 B_1 - (J_2 + J_5) B_2 + J_5 B_3 &= 0 \\ J_4 B_2 - (J_4 + J_7) B_3 + J_7 B_4 &= 0 \\ J_6 B_3 - (J_6 + J_9) B_4 + J_9 B_5 &= 0 \end{aligned}$$

etc. etc.

being one equation for each mill after the first, or one equation for each wet-crushing unit, and where in the last equation applicable the highest J occurring must be replaced by W, the maceration water, and the highest B by zero, the Brix of that maceration water.

Since the J's are all known, as they can readily be calculated from the fibre percentages in the bagasse, we have to solve the above set of equations in order to determine the ratio B_1 to the B for the last mill, say the n th.

The elementary procedure is to determine the value of B_2 in terms of B_3 and known quantities from the first equation; insert this value in the second, and determine thence B_3 in terms of B_4 and known quantities; and so on, the last operation giving B_n in terms of B_1 and W, together with the various J's. For a couple or so of the equations this is not difficult, but as the number of equations taken increases, the labour rapidly becomes very great, and it is much better to turn to more powerful mathematical methods, which give the desired result at once, and in a much better form. The results can be determined in the manner indicated, but quite an elementary knowledge of the Theory of Determinants is sufficient to enable the general solution to be at once obtained in simple form.

Now, using the determinant notation, we have, immediately $B_1/B_n = P/Q_n$ where

$$\begin{aligned} P_n &= \begin{vmatrix} -(J_2 + J_5) & J_5 & 0 & 0 & 0 \\ J_4 & -(J_4 + J_7) & J_7 & 0 & 0 \\ 0 & J_6 & -(J_6 + J_9) & J_9 & 0 \\ & 0 & & & J_{11} \\ & & & & \text{etc.} \end{vmatrix} \\ Q_n &= \begin{vmatrix} J_1 & -(J_2 + J_5) & J_5 & 0 & 0 & 0 \\ 0 & J_4 & -(J_4 + J_7) & J_7 & 0 & 0 \\ 0 & 0 & J_6 & -(J_6 + J_9) & J_9 & 0 \\ 0 & 0 & 0 & J_8 & -(J_8 + J_{11}) & J_{11} \\ & & & & & \text{etc.} \end{vmatrix} \end{aligned}$$

where $n - 1$ rows and $n - 1$ columns must be taken in each case. [A $(-1)^n$ which ultimately cancels out is omitted].

The second determinant at once shows that $Q_n = J_1 J_4 J_6 \dots J_{2n-2}$.

To reduce the determinant for P_n , leave the first column; add the first and second for a new second; add the first three for a new third; and so on, giving

$$P_n = \begin{vmatrix} -(J_2 + J_5) & -J_5 & -J_7 & -J_9 \\ J_4 & -J_7 & 0 & 0 \\ 0 & J_6 & -J_9 & 0 \\ 0 & 0 & J_8 & -J_{11} \\ & & & \text{etc.} \end{vmatrix}$$

which immediately shows that

$P_n = J_{2n+1} P_{n-1} + J_2 J_4 J_6 \dots J_{2n-2} = J_{2n+1} P_{n-1} + Q_n$
[again omitting a $(-1)^n$, which cancels out with the one previously mentioned],
and finally $R_n = B_1/B_n = P_n/Q_n = J_{2n+1} P_{n-1}/Q_n + 1$

We have, in succession

$$\begin{aligned} P_1 &= 1 & Q_1 &= 1 \\ P_2 &= J_2 + J_5 & Q_2 &= J_2 \\ P_3 &= J_7 (J_2 + J_5) + J_2 J_4 & Q_3 &= J_2 J_4 \\ & \text{etc.} & & \text{etc.} \end{aligned}$$

so that, on replacing in each case, the J with the highest suffix by the maceration water W

$$R_1 = 1$$

$$R_2 = W/J_2 + 1$$

$$R_3 = W(J_6 + J_2)/J_2J_4 + 1$$

$$R_4 = W(J_7(J_3 + J_2) + J_2J_4)/J_2J_4J_6 + 1$$

$$R_5 = W(J_9(J_7(J_3 + J_2) + J_2J_4) + J_2J_4J_6)/J_2J_4J_6J_8 + 1$$

$$R_6 = W(J_{11}(J_9(J_7(J_3 + J_2) + J_2J_4) + J_2J_4J_6) + J_2J_4J_6J_8)/J_2J_4J_6J_8J_{10} + 1$$

etc.

and it should be noticed that these expressions are correct right down to R_2 for two mills only with water on the single intermediate carrier, and even down to R_1 for a single mill without maceration at all, for which it is shown that $R_1 = 1$, and the Brix of the residual juice is the same as that of the normal juice.

For the special case where all the bagasse has the same fibre content, it is easily seen that all the J's with even suffixes become equal to J_2 , and all the J's with odd suffixes become equal to W, and then, if $W/J_2 = K$, the above expressions readily reduce to

$$R_n = 1 + K + K^2 + \dots + K^{n-1} \text{ which is } R_n = (K^n - 1)/(K - 1), \text{ or } n \text{ if } K = 1.$$

In the original article in the *Engineer*, I gave a table of the weights of the residual juice in the bagasse, for different fibre contents of the cane and of the bagasse, which greatly facilitates the calculations, as the J's with even suffixes are simply taken directly from the table.

There is one other point that should be mentioned, and that is, Mr. Deerr's footnote on page 403, to the effect that the general expression for mill extraction with compound maceration is also the general expression for the extraction in a diffusion battery. I am unable to agree with this, as with mills each extraction is a single operation, while with a diffusion battery the operation may be continuous. Consider the last vessel of a diffusion battery, the beets (say) in which contain 1 lb. of juice at a Brix of B, and let it be extracted with K lbs. of water as a single operation: the Brix ratio R_1 will then be $1 + K$ and the extraction $E_1 = 1 - 1/R_1$. If the extraction, with the same amount of water, is performed in two operations, we shall have $R_2 = (1 + K/2)^2$ and $E_2 = 1 - 1/R_2$; and generally, for n operations, $R_n = (1 + K/n)^n$ and $E_n = 1 - 1/R_n$. Now, with a continuous flow, as in a diffusion battery, the extraction may be considered as being performed an infinite number of times with an infinitesimally small quantity of water each time, and therefore we shall have R_n = the limit of $(1 + K/n)^n$ when $n = \infty$, which is of course e^K , e being, as usual, the base of the Napierian logarithms, so that $R_\infty = e^K$ and $E_\infty = 1 - 1/e^K$. For example, if $K = 1$, or the juice is extracted with an equal weight of water, a diffusion cell will give a theoretical Brix ratio of $e = 2.718 \dots$ and an extraction of $1 - 1/e = 63.2$ per cent., whilst a cane mill will give $R = 2$ and $E = 50$ per cent. only.

Calculations for the earlier cells of a diffusion battery are more complex, as the extraction is performed, not with water at zero Brix, but with juice whose Brix varies continually during the flow, and it may be expected that the mathematical expressions will become complex with a number of vessels in the battery. The only procedure to obtain such expressions would be to form differential equations between the Brix of the juice being extracted and that of the juice used for the extraction, for each vessel in succession; to integrate these, and then eliminate all the Brix values except the first and last—a somewhat tedious task, though probably not really difficult.

The Sugar Industry in Mauritius.

Department of Agriculture Report for 1920.

The publication of the Report of the Department of Agriculture of Mauritius for 1920, as prepared by Dr. TEMPANY, follows hard on that of 1919, which we were able to publish only last February. Reference should be made to that issue¹ for certain tables of statistics relating to previous seasons.

The following figures give the final estimate of the 1920-21 crop compared with the total output of the seven preceding years.

1920-21 Sugar Crop—Final Estimate—in 000 Metric Tons.

Final Estimate 1920	1919	1918	1917	1916	1915	1914
258.90	.. 235.19	.. 252.77	.. 226.0	.. 208.97	.. 214.53	.. 277.36

Yield of Veson Sugar.—Of the estimated crop of 258,000 metric tons for 1920-21, approximately 95.2 per cent. will, it is anticipated, consist of *vesou* sugar; only 0.2 per cent. of first syrups and 4.6 per cent. of low syrups will probably be manufactured. Between the years 1911-1918 the proportion of *vesou* has very greatly increased; the result is due largely to improvements in methods of manufacture and also to the policy which factory proprietors have wisely followed during more recent years of returning one grade of white sugar only instead of two as was formerly the case.

Factory work of 1920-21.—The average extraction of sugar for the crop is estimated to be 10.7 per cent. of the weight of cane handled; final figures are not yet available.

The total tonnage of cane crushed for the crop of 1919 amounted to 2,258,040, giving a mean extraction of commercial sugar of 10.42 per cent. of cane. The corresponding figure in 1918 was 10.95—the highest on record. The highest mean extraction for any single usine during 1919 was 11.81 per cent. and the lowest 8.69 per cent.

During the year 1920, 54 factories operated; there has been no alteration in the number of factories at work in the Colony since the year 1918.

Very considerable improvements have been introduced into a number of factories during the past year; complete figures for new installations are not as yet available; improvements introduced have comprised machinery imported from England, France and America, and also machinery manufactured at the local foundries.

In this connexion, local firms have manufactured and installed the following items during the year: eight cane carriers, one mill, six sulphitation apparatus, eight defecators, six filter presses, five juice heaters, four juice strainers, one triple effect, four quadruple effects, six vacuum pans, one barometric condenser, eight air pumps, 13 juice and magma pumps, 11 fans for induced draught, four air compressors and three boilers.

The determination shown by sugar manufacturers to invest a reasonable proportion of the profits consequent upon the high prices in improving factory installations is a satisfactory feature of the present position. Further large orders for machinery are now being placed by almost all factories and the coming year will witness a marked further advance in respect of the standard equipment of the average Mauritian factory.

Sugar manufacturing operations were conducted under difficulties in certain localities, by reason principally of labour shortage and also troubles consequent

¹ *I.S.J.*, 1921, 81-86.

on new installations ; difficulties were also encountered owing to shortage of water on a number of estates before the end of the crop.

Area under cultivation.—At the end of 1919, the total area under sugar cane was estimated to be 170,752 acres, a figure practically identical with that of the preceding year. During 1920 increases of area under cultivation took place in a number of localities ; the exact extent of these increases is not known but they are estimated to amount at least to 2000 acres ; of these increases, the most noteworthy have occurred in the District of Black River where the extension of La Ferme Irrigation Scheme has led to considerable blocks of land formerly derelict and estimated at a minimum of 600 acres being placed under cane.

Yields of canes in the field were satisfactory in the centre and south of the Island ; in the north, fair yields were obtained, in the lower parts of Flacq poor yields were encountered in places while in Black River poor yields were rather frequent.

The reaping of the crop proceeded with considerable difficulty on many properties owing to labour shortage, but few had contrived to finish the crop before Christmas, 1920, and about a dozen were forced to continue operations in January, 1921.

Area cultivated by Indian Proprietors.—The area cultivated by Indians during the year 1920 has shown an appreciable increase, though the exact figures are not yet available. The high prices which the Indian planters have received for their canes have added very materially to the prosperity of this section of the community. The effect has further been seen to a very marked degree in the increased shortage of labour and in the greatly enhanced prices paid for labourers' wages.

Effect of labour shortage on agricultural operations.—The effect of the shortages of labour has been felt to a marked degree on estates and is witnessed by difficulties experienced in the reaping of the crop and also in the performance of cultural operations.

The following table gives an idea of wages currently paid to day labourers and the cost of agricultural operations during the year. In some cases these figures have been considerably exceeded.

	Rs.	Rs.
Day labourers..	2.00 —	3.00
Female labourers	0.75 —	1.00
Clearing land	150.00 —	350.00 per arpent
"Fosseyage"	50.00 —	90.00 "
Manuring..	10.00 —	20.00 "
Weeding	50.00 —	80.00 "
Cutting cane	30.00 —	50.00 "

It is to be feared that the results will be seen practically everywhere in a marked lowering of the standard of cultivation adopted ; in consequence increased attention is now being devoted to the adoption of labour-saving devices with a view to economizing hands. In this connexion consideration has been given to the question of the introduction of tractors and implements for the performance of agricultural operations.

One tractor has already been introduced for experimental purposes while a scheme is under consideration for the introduction of several tractors of different makes and their trial on a considerable scale under the auspices of the Government and planters. Some extension has already been seen in the employment of ploughs and cultivators drawn by animals. Many, though not all, of the lands of Mauritius are quite well adapted naturally to implemental cultivation, and by the introduction of this system wherever possible great savings of labour are capable of being effected.

The Sugar Industry in Mauritius.

Irrigation of sugar cane.—Considerable progress was made during the year towards the completion of the La Ferme Irrigation Scheme for the District of Black River and it is anticipated that the reservoir and distributary canals will be completed during 1921. In anticipation of the completion of the scheme, considerable additional areas were placed under cultivation during the year; at the end of 1920, the area planted under irrigation of La Ferme water amounted to 2600 acres as compared with 1400 acres at the end of 1917; it is anticipated that when the work has been completed, from 3000 to 3500 acres will be capable of being irrigated under this scheme. Cane returns from irrigation plantations have been rather disappointing. Much attention has been devoted to the question of the need for experimental investigations in relation to the irrigation of sugar cane with a view to ascertaining the causes for the low yields which have been experienced and to endeavour to formulate a satisfactory system of cultivation for irrigated lands.

A proposal is now under consideration for the establishment of an Experiment Station in the Black River District with this object in view.

In relation to the irrigation project for the northern district known as the La Nicolière Scheme, operations on the construction of the dam were commenced during the year. To finance this scheme arrangements were made under Ordinances No. 8 of 1919 and No. 6 of 1920, to raise a loan of Rs. 500,000 in the form of debentures at 6 per cent., repayable in 1934.

Disposal of the sugar crop.—With reference to the disposal of the sugar crop of 1920, during the month of May negotiations were entered into between the Royal Commission on the Sugar Supply and the Chamber of Agriculture representing the sugar planters of Mauritius; these negotiations were conducted through the firm of Messrs. BLYTH BROS. & Co.; as the result, arrangements were concluded for the sale of not less than 90 per cent. of the *vesou* output of the crop at a price of 90s. per cwt., f.o.b. Mauritius, for fine to finest quality, a deduction of 1s. per cwt. being made between the first and second quality *vesou* and a further 1s. per cwt. between second and third quality *vesou* as obtained in the previous year. The financing of the transaction was arranged through the local banks.

Practically all planters have adhered to the Sugar Planters' Syndicate and the entire *vesou* crop of the Colony will pass into hands of the Royal Commission with the exception of a few small lots which have been sold privately, and of about 5000 tons which have been reserved for local consumption.

With regard to the disposal of the crop of 1919, the final settlement for *vesou* per 50 kilos was as follows: Class A, Rs. 22.68; B, Rs. 22.18; C, Rs. 21.68; these figures do not include charges for brokerage and commission. More than 95 per cent. of the *vesou* coming from estates in the Syndicate entered into Class A.

Pests and diseases of sugar cane during 1920.—In relation to pests and diseases, a very important decrease has been recorded in the incidence of the serious pest known locally as "Moutouc" (*Phytalus Smithi*). It will be recalled that this insect was introduced into this Colony somewhere about 1907; in 1911, it manifested its presence in the Districts of Pamplemousses as a very serious enemy of the cane which occasioned widespread and severe loss; control measures under Government supervision were undertaken in that year and have been maintained under the supervision of the Department of Agriculture.

The principal methods of control adopted have comprised the collection of adult beetles and of larvæ and the introduction of the parasitic enemy *Tiphia parallela*, which was successfully imported from Barbados in 1915 and has established itself in the infected areas. The following figures give the number of insects captured each year since the commencement of the campaign:—

YEAR.		BETTERLES CAPTURED.	YEAR.		BETTERLES CAPTURED.
1911-12	....	26,460,187	1916-17	....	72,292,689
1912-13	....	16,055,556	1917-18	....	70,035,663
1913-14	....	36,484,130	1918-19	....	71,119,278
1914-15	....	51,356,507	1919-20	....	30,969,504
1915-16	....	42,511,241			

The reduction in the number of insects captured in 1919-20 is undoubtedly due to a reduction in the incidence of the pest as the result of the various repressive measures which have been adopted. On certain properties which were formerly heavily infected, the infestation has now been reduced practically to nothing. On the other hand, the insect continues to manifest a tendency to extend the area of infestation and in order to check this tendency as far as possible, an elaborate system of patrol of the periphery of the infected area by collecting gangs has been inaugurated during the past two years. The importance of the work accomplished has been recognized by the planting body to the extent that by arrangement with Government a special export tax of 2 cents of a rupee per 100 kilos of sugar is now levied on all sugars leaving the Colony for the purpose of supplying funds for more extended activities. Under this Ordinance, a sum approximately Rs. 50,000 has this year been made available for the work, and it has in consequence become possible considerably to extend operations against the pest during the year. Without being unduly optimistic, there appears good reason to hope that within the next few years the evil effects of this insect will have become very greatly ameliorated if not entirely removed.

In relation to the other insect and fungoid enemies of the sugar cane, the "Gros Moutouc" (*Oryctes tarandus*), has been sensibly less in evidence on certain properties in Savanne where it was formerly a serious pest; this result is due to repressive measures adopted by the estates. The parasitic enemy of this insect (*Scoliu Oryctophaga*) imported from Madagascar in 1917, has probably established itself in the Colony but so far is not in evidence as a control of *Oryctes* on cultivated lands. Other insect pests of the cane have not been markedly in evidence during the year.

Root disease of sugar cane has again been in evidence on certain properties but to a rather less extent than in former years, probably in consequence of the application of the remedial measures which had been recommended by the Department of Agriculture.

Experimental investigations in relation to the Sugar Industry in Mauritius.—Experimental investigations on certain phases of the sugar industry have been continued during the year by the Department of Agriculture, the principal have comprised the continuation of trials with manures and with varieties of canes. The result of the series of manurial experiments conducted between the years 1913-18 have been published in the form of a bulletin. The trial comprised numerous repetitions of experiment with the different manurial combinations on plots 1/20th of an acre situated in the fields of sugar estates in the Colony. The plan adopted in laying out these experiments is in accordance with practice accepted in experimental work all over the world, the size of the plot being in accordance with the determinations of WOOD, HARRISON and others who have demonstrated that plots of these dimensions are the most satisfactory for experimental purposes.

The results of these trials have shown that applications of sulphate of ammonia and nitrate of soda to canes which have received dressings of pen manure may produce substantial increases in yield but that these increases are dependent

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on the presence of other limiting factors. The commercial profit is a question of the relative value of manures and canes. The effects of potash and phosphate are more variable.

Fresh trials are being laid down to investigate a number of points arising from these experiments. In relation to cane varieties, the work of investigation has been defined and systematized and now comprises the raising of seedlings; their selection and trial on one hole plots in the field; the further selection of those and trial of the best on six hole plots; re-selection and trial of the most promising on 30-hole plots at Réduit and Pamplémousses and final re-selection and trial on co-operative 60-hole plots situated on estates throughout the Colony. This is combined with the importation and trial of promising seedlings from other parts of the world.

During 1918, this system was got into working order and there exist nine stations in connexion with these trials at different points of the Colony. The work of raising and trying out seedling canes is of high importance, since it affords the only means known of replacing standard varieties which, after prolonged cultivation, inevitably tend to exhibit degeneration.

As the result of the work which has been accomplished, the Department of Agriculture is now in a position to recommend with some degree of confidence, a number of new seedling canes, which it is hoped to place at the disposal of the planting body during 1921.

Production of alcohol.—The production of rum from the waste molasses of the Sugar Cane Industry forms a not unimportant subsidiary industry. At present, there are three distilleries operating in the Colony; formerly they were much more numerous. The methods of production are in general capable of considerable improvement.

The total production of alcohol for the past six years, according to Treasury Returns, is as follows:—

1919-20	....	1,666,000 litres	1916-17	....	1,883,607 litres
1918-19	....	1,529,315 „	1915-16	....	1,410,174 „
1917-18	....	1,602,414 „	1914-15	....	1,091,485 „

A certain portion of this is exported, principally to the Seychelles and Rodrigues, a further amount is denatured for domestic and industrial purposes; the greater part however enters into human consumption locally.

The majority of the molasses produced in the Colony is at present used as a fertilizer. Of late years, increased attention has been devoted to the possibilities of alcohol for power purposes. A number of attempts have been made to utilize alcohol and mixtures of alcohol and ether as a substitute for motor spirit, but so far, for various reasons, these have not been attended with a very great amount of success. There is however undoubtedly great scope for very large developments in the production of alcohol for power from the waste molasses of the sugar industry, while the fertilizing constituents of the molasses so employed need not be lost as they are capable of being returned to the land as spent liquors after distillation.

During the year, the manufacture of alcohol in the Colony has been made the subject of investigation by a Commission appointed by the Governor, the scope of the inquiry including both the consumption of the alcohol for drinking and its industrial application. The Report of the Commission appeared at the end of 1920 in respect of the use of industrial alcohol for the purpose of providing power. The Commission laid very great stress on the importance of this matter to the Colony; they also emphasized the indifferent quality of distillery work as at present carried on in Mauritius.

The Czecho-Slovakian Beet Sugar Industry during 1920-21.

A Department of Overseas Trade Report on Czecho-Slovakia, prepared by the Commercial Secretary to the British Legation at Prague, gives the following account of the sugar industry in that country.

Czecho-Slovakia is the largest exporter of beet sugar and the second largest beet producing country in the world.¹ The important rôle that the sugar industry was destined to play in the industrial and economic development of the Republic did not, however, become apparent until the beginning of the year 1919 when the Czech krone began to fall. Then the value of sugar destined for export increased in value in the same ratio as the krone depreciated, and the export of sugar began to be regarded as one of the means of stabilizing the exchange. Hence a return to the most primitive form of trade—barter. The year 1919 stands out as the year of “compensation agreements.”

The decreased production of Java sugar and the fears that the European beet crop would not come up to expectations were mainly responsible for the unexampled demand for sugar which ensued in the year 1919. The prohibition of alcohol in the U.S.A., too, caused a marked increase in the consumption of sugar, and America, who during the war had exported sugar in large quantities, found herself unable to supply her own needs and started buying up sugar from all available sources.

America bought up the last bag of Czecho-Slovakian sugar at \$44 f.o.b. Hamburg (March, 1920), whereas in October, 1919, the highest obtainable price was \$26½. The 1919-20 season, however, was the most difficult ever experienced in the history of the Czecho-Slovakian sugar industry. The season was continually hampered by insufficient deliveries of coal and lack of rolling stock. But in spite of all difficulties the sugar industry from the fruits of its labours provided the means for building up the whole economic life of the Republic. Her exports of sugar enabled Czecho-Slovakia to acquire the foreign currency with which to purchase food for her population and to provide the necessary raw materials to keep her extensive industries going.

At the beginning of the 1920-1921 season the situation, however, changed. The effects of the enormous speculative buying which took place early in 1920 began to make themselves felt, especially in America, when in June, 1920, the sugar purchased from all parts of the world began to arrive in American ports, and for which there were no buyers at the prices then quoted. In August prices literally tumbled down. These happenings had a very serious effect on the Czecho-Slovakian market. Whereas in the previous year important sales of sugar of the coming season had been effected, this year would-be buyers were frightened away at the high prices which the State demanded. The Government, who were hampered in their sugar dealings by the fact that they were forced to use sugar as a means of acquiring foreign currency and raw materials from abroad, held their stocks for higher prices, but their hopes were not realized.

During the period October-November, 1919, Czecho-Slovakia exported 69,275 tons of sugar, during the same period of 1920 only 16,125 tons. From 1st May,

¹ Of Europe. The compiler of this report has overlooked the U.S.A. beet sugar industry, which comes second in the world's lists.—Ed., *I.S.J.*

The Czecho-Slovakian Beet Sugar Industry during 1920-21.

1919, to the 31st March, 1921, she exported about 477,058 tons of sugar representing a value of K.5,026,755,257. Of this sum the manufacturers were paid a sum of K.1,695,664,728, leaving a gross profit to the State of about K.3,331,090,529.

The decontrol of sugar in England which took place in February of this year was not without its effects on the Czecho-Slovak sugar market. Within a few weeks England purchased over 300,000 quintals. This demand, however, has temporarily fallen off owing to the coal strike.

The prospects for the coming season 1921-1922 are not very promising owing to the existing differences between the beet growers and the manufacturers as to the price to be paid for beet. The Government has fixed the price for beet at K.30 per quintal, a price which, the manufacturers assert, will make sugar production unprofitable.

THE SUGAR PRODUCTION OF CZECHO-SLOVAKIA DURING THE SEASONS 1918-19, 1919-20, 1920-21.

	REFINED. METRIC TONS.	CRYSTALS. METRIC TONS.	RAW SUGAR. METRIC TONS.	TOTAL IN EQUIVALENT OF RAW SUGAR. METRIC TONS.
1918-19	171,829	291,136	95,963	623,744
1919-20	178,467	238,902	31,615	507,416
1920-21 Bohemia ..	144,610	160,314	38,991	386,605
Moravia ..	94,980	90,887	20,008	231,897
Silesia ..	9,523	1,614	3,055	9,641
Slovakia ..	5,544	58,867	2,685	70,744
1920-21 Total ..	254,659	311,683	53,259	698,899

SHOWING THE AREA OF LAND UNDER BEET CULTIVATION, THE BEET HARVEST, AND SUGAR PRODUCTION IN CZECHO-SLOVAKIA DURING 1920-1921 (TO 31st MARCH, 1921).

	BOHEMIA.	MORAVIA.	SILESIA.	SLOVAKIA.	TOTAL.
Number of factories working :					
(a) Refineries	7	4	1	—	12
(b) Mixed factories	20	19	2	8	49
(c) Raw sugar factories	85	24	3	—	112
(d) Beet preparing factories	104	43	5	8	160
Land under beet cultivation, in hectares	105,078	58,923	3,443	25,420	192,864
Quantity of beet worked in metric tons :					
(a) for production of sugar	2,248,286	1,376,483	68,601	506,970	4,200,340
(b) for other purposes	35,276	24,403	294	1,840	61,813
Raw sugar value in metric tons :					
Sugar production	386,605	231,898	9,642	70,745	698,899
Syrup production	81	27	—	—	109
Home consumption of sugar	97,216	37,974	6,539	25,794	167,524
Home consumption of syrup	1797	882	—	167	2,846

Mr. A. GIBSON, of the Natilite Motor Spirit Co. of Australia, Ltd., has applied to the Australian Commonwealth Government for a concession for the right to use the nipa palm on the delta and around the mouth of the Fly River, New Guinea. He guarantees to produce 500 tons of paper weekly, and three million gallons of alcohol motor fuel annually.

The attention of those desiring to take up the study of Fermentation is directed to the School of Malting and Brewing and Department of the Biochemistry of Fermentation, the director of which is Prof. ARTHUR R. LING, M.Sc., F.I.C. It is attached to the University of Birmingham, and offers course of instruction in Brewing and Fermentation Technology ; Bacteriology ; Botany and Vegetable Physiology ; Engineering ; Physics and Chemistry.

Chemical Control Results obtained in Hawaii during the 1920 Season.¹

By E. T. WESTLY.

After showing a steady improvement from year to year in factory results,² the 1920 crop showed a slight decrease in average figures. This decrease was found in the boiling-house only, for the quality of milling was better than any previous year. The lower boiling-house recovery off-set any gain in the milling department, and is attributed largely to a strike of labourers on one of the islands where five of the largest plantations are located. On these plantations inexperienced labour had to be employed in the factory, and this, together with delayed harvesting, resulted in poorer factory work and higher purity molasses.

The improvement in milling was, to a great extent, due to additions made to the milling equipment of several of the mills, but many mills with old equipment showed improvement in extraction over last year's figures. Better milling results than for the previous crop were reported by 64 per cent. of the factories. One gave an average extraction of over 99 per cent. The average for all was 97.45 per cent. as against 97.30 per cent. last year. The milling loss, that is, the sucrose lost per 100 of fibre in the bagasse, was 2.75 per cent. as against 2.97 per cent. for 1919. The average moisture in bagasse was reduced from 41.57 per cent. to 41.05 per cent. These results were obtained in spite of a lower polarization of cane, a higher fibre content, and a lower maceration at the mills. One factory, equipped with a nine-roller mill and crusher, obtained an average extraction of 98.13 per cent., which undoubtedly constitutes a record. As in former years, the tons crushed per hour was low, although one mill for part of the season put through a large tonnage. This was a 15-roller mill and crusher equipped with a Searby shredder. Through this mill 100,000 tons of cane were crushed at an average rate of 77.53 short tons per hour. During this period with 30 per cent. dilution of normal juice, an average extraction of 98.98 per cent. was obtained. During one trial the tonnage on this mill was increased to 101 tons of cane per hour.

Much time, thought, and money has been spent in improving milling in Hawaii during the past ten years, but not in vain. The loss in polarization per 100 polarization in cane was in 1911, 6.41, and in 1920, 2.75, corresponding to 41,477 and 16,500 tons of polarization assuming a crop of 4,625,260 tons of cane in both cases.

Considering now boiling-house work, we find that the loss in press-cake was greater in 1920 than in several former years and a greater production of press-cake was produced per 100 cane. The increase in the quantity of press-cake production is probably due to a higher moisture content. Syrup densities were lower than in any year since 1914, in spite of lower maceration at the mills.

The average gravity purity of waste molasses was 38.75 per cent. as against 37.95 per cent. for the previous season. This increase was due to poorer results in the factories affected by the strike, and also to the fact that the work in four small factories producing high purity molasses was included in this year's figures, but not in previous ones. A few factories, however, reported very low molasses. One had an average for the season of 33.95 gravity purity, but a number report over 40.00 gravity purity, which is considered unnecessarily high.

There has been an increase in undetermined losses, and the average of 2.03 is far too high. Below is given the average losses per 100 polarization in cane for the Hawaiian factories during the past two crops:—

¹ *Sugar News*, 1921, 2, No. 1, 121.

² *I.S.J.*, 1920, 471.

Chemical Control Results obtained in Hawaii during the 1920 Season.

	1919.		1920.
In bagasse	2.70	....	2.55
In press-cake	0.03	....	0.04
In waste molasses	7.24	....	8.03
In undetermined	1.46	....	2.03
Total	11.43	....	12.65

The following 1920 averages for Hawaiian factories may be of interest:— First expressed juice. 19.32° Brix; 16.85 pol.; 87.24 purity; while the Java ratio, that is to say, polarization of the cane times 100, divided by polarization of first-expressed juice, was 80.9. Mixed juice: 13.48° Brix; 11.31 pol.; 83.87 purity.

Polarization of last-mill juice was 1.65 and the purity 68.20. Maceration was 39.95 per cent. per 100 cane. Average Brix of syrup was 61.34 per cent., purity 85.20 per cent. Average polarization of the sugar bagged was 96.36. It took an average of 8.12 tons of cane to make 1 ton of sugar, the lowest record by any plantation being 6.54 and the highest 10.22. Polarization per cent. cane was 13.64 and fibre per cent. of cane was 12.64.

Comparing the above figures with the average figures of the Central Luzon (Philippines), one finds that the crusher juice density is about the same as in Hawaii, but the local purities are not much over 80 or 82. In the Philippines the polarizations of cane run slightly over 12 per cent. with fibre at about 11.5 per cent., while the quality-ratio of Central Luzon cane is found to be in the neighbourhood of 9 to 1.

Manufacture of High-Purity Crystalline Anhydrous Dextrose (Glucose).¹

By CHR. E. G. FORST, Director, Research Laboratory, Corn Products Refining Co., Edgewater, New Jersey, U.S.A.

Starch conversion products made prior to 1880, and known as "corn sugar," "corn syrup," etc., were not chemically pure sugars. They were solidified dextrose solutions containing the mother liquor, in which was dissolved mineral matters, dextrin and other impurities.

In the year mentioned, a chemist prominent in the Corn Products industry, ARNO BEHR, took out a patent for the manufacture of anhydrous dextrose. His invention led to the building of the Chicago Sugar Refining Company, which was erected at a cost of \$1,250,000 for the manufacture of this product alone. During the year 1883 however it was converted into a plant for the general manufacture of corn products, as it was found that the market was not developed enough for "anhydrous sugar," which seldom reached a purity higher than 98 per cent.

BEHR prepared his anhydrous sugar in the following way: A sugar solution of proper density was allowed to crystallize in specially constructed cast-iron forms, at a temperature favourable to the crystallization of the anhydrous form of dextrose crystals. After proper curing, the cast-iron forms were placed in centrifugals, and the mother liquor eliminated by spinning. This process of centrifuging of already solidified sugar was afterwards abandoned, as it was costly and wasteful. It was superseded by the pressing process, which in the meantime had been developed to perfection by Mr. CHAS. EBERT, at that time Superintendent of one of the factories belonging to the Corn Products Refining Company. The finished sugar was sold under the trade name of "Cerelese."

¹ Abstract of a paper read before the Sugar Section of the American Chemical Society, 1921.

During the year 1911, I had an opportunity to study the development of the entire industry of the manufacture of dextrose. It appeared to me that modern centrifugal machinery should be able to separate dextrose crystals from a masse-cuite of proper gravity grown under proper conditions. The apparatus which was available at the time for this purpose was not suitable. It consisted of an earthenware stone crock, equipped with a wooden propeller for stirring the masse-cuite during the crystallization, and a hand centrifugal. The basket of the latter I lined with a cotton duck cloth, and afterwards with copper screens representing various meshes. There was also available a small vacuum dryer for curing the finished crystals.

Numerous experiments, more or less successful, were carried out, and small amounts of white anhydrous dextrose of high purity were made on a laboratory scale. A sufficient quantity of a product which was almost 100 per cent. pure was made to supply certain laboratories and hospitals.

During the summer of 1915, I visited the Bureau of Standards in Washington, and was very cordially received by Messrs. FREDERICK BATES and R. F. JACKSON, of the Sugar Laboratory, and was given detailed information regarding the work which was being carried on in the manufacture of chemically pure dextrose. Although the ultimate results desired were different from Jackson's, and although I was using different methods, his scientific work¹ and advice have been of great assistance ever since in producing a dextrose of high purity.

About the same time, the Corn Products Refining Company at Edgewater changed superintendents, and for a few years it was my privilege to co-operate with Mr. CHAS. EBERT, whose services were invaluable in promoting the work. During this period we were assisted by a Danish sugar chemist, Mr. C. C. WINTHER. Through his help there was installed a large crystallizer, centrifugal, and drying apparatus; and for the first time a pure dextrose of white colour was prepared on a manufacturing scale.

In June, 1919, through the courtesy of the Bureau of Standards, Mr. W. B. NEWKIRK, an associate chemist from the Sugar Laboratory, visited our experimental plant to supervise the needed experimental work in the manufacture of dextrose. He had had a varied training in the beet sugar industry, and was a skilled technician in the art of boiling and graining sugar. It was demonstrated that it was possible to produce commercial white dextrose of over 99 per cent. purity from darkly coloured solutions. Specifications were then prepared from Mr. Newkirk's suggestions for modern experimental¹ equipment, such as is used in the manufacture of sucrose. This was ordered and installed at our Edgewater plant for the production of a white crystalline anhydrous dextrose on a large manufacturing scale.

During the last years of experimental work the Corn Products Refining Company has produced several thousand pounds of C.P. dextrose. Based on information which had been received during these years from various physicians who had had an opportunity to use dextrose, a series of hospital investigations and feeding experiments were undertaken, the results of which are given in Dr. Wm. H. Porter's lectures published in miscellaneous medical periodicals. The results clearly show the therapeutic value of dextrose of high purity.

* * * Through the courtesy of the Corn Products Company, of Edgewater, New Jersey, we have received a sample of the C. P. Dextrose mentioned in the above article. It is a pure white product, in the form of a fine powder.

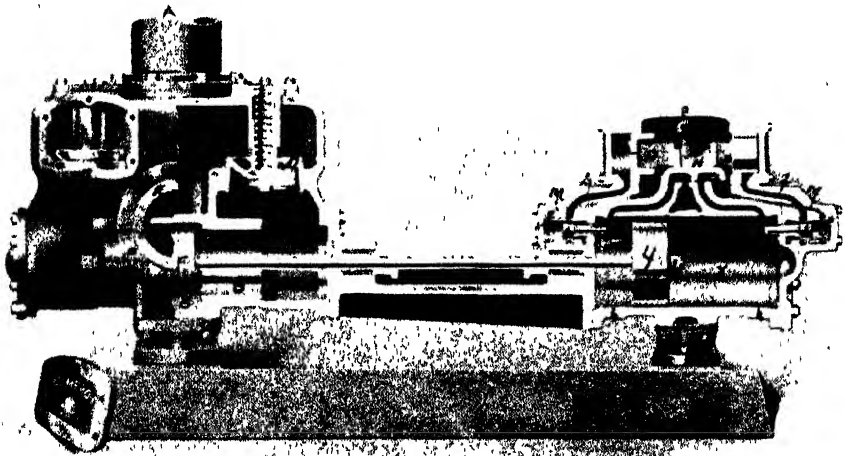
¹ See Scientific Paper of the Bureau of Standards, 293 :—"The Saccharimetric Normal Weight and Specific Rotation of Dextrose," by R. F. JACKSON.

Magma Pumps.

The development of a special type of Cameron pump for pumping magma, or the mass of crystals and molasses resulting from the boiling down of sugar cane juice, is a very important step forward in the manufacture of pumping machinery. This pump, although specially designed to handle magma, will pump any viscous fluid such as molasses, tar, or the heavier crude oils.

These Cameron magma pumps are of the direct-acting piston plunger type, operated either with steam or compressed air. The pump end is of special construction, with ports of such generous proportion that the liquid and foreign matter, held in suspension, are afforded unimpeded passages; also the discharge valves instead of being of the flat type are bowl-shaped and easily reseal themselves by the enclosed valve spring when the piston starts in the reverse direction. These discharge valves are particularly simple in construction, operate in a vertical plane, and are very accessible.

The pump cylinder has either a removable cast-iron or a bronze bushing through which a solid grooved piston works. The grooved piston has the effect of helping to keep the bushing lubricated, and also, as this pump is designed to handle viscous fluids, these grooves eliminate the necessity for packing of any kind.



Referring to the sectional view of the pump, *G* is the cylinder; *F* is the piston; and *A* the port connected with the source of supply. The necessity for inlet valves is eliminated by having the pump placed below the level of the source of supply. In this way the fluid comes readily into the pump through port *A*. From this port it passes into chamber *B*. The piston *F* in its travel closes the port *B*, leaving the fluid free to pass into the opposite end of the cylinder *G*, in which a partial vacuum has been created. The return of the piston forces the fluid into chamber *C* and up through bowl valve *D*. The discharge opening is designated by the letter *E*.

The driving end is of the standard construction that has given Cameron pumps their reputation for unequalled simplicity and reliability over a period of more than sixty years. While this steam-thrown valve construction is doubtless well

known to persons familiar with pumping machinery, a short detailed description of its action is given below. It will be noted that there are only four working parts in the steam mechanism; also that the certainty of valve action is secured without the attendant levers, rocker arms and cams. There are no rods to bend, break, or get out of alignment; no tappet bars, rollers or clamps to be adjusted.

Referring to the sectional view of the steam cylinder, *Y*, the piston, is driven by admitting the steam or compressed air under the slide valve *H* which, as it is shifted backward and forward, alternately connects opposite ends of the cylinder *X* with the inlet and exhaust lines. This slide valve *H* is shifted by the auxiliary plunger *P*; *P* is hollow at the ends which are filled with steam, and this issuing through a hole in each end, fills the space between it and the heads of the steam chest in which it works. Pressure being equal at both ends, this plunger *P*, under ordinary conditions, is balanced and motionless; but when the piston *Y* has travelled far enough in its stroke to strike and open the reverse valve *I*, the steam or air exhausts through the port *Z*, from behind the ends of the piston *P*, which immediately shifts accordingly and carries with it the slide valve *H*, thus reversing the pump. No matter how fast the piston may be travelling, it must instantly reverse on touching valve *I*. In its movement the plunger *P* acts as a slide valve to close the port *Z* and is cushioned on the confined steam between the ports and chest cover. The reverse valves *II* are closed as soon as the piston *Y* leaves them, by a constant pressure of steam behind, which is conveyed direct from the steam chest through the ports indicated by shaded passages *M*.

Magma pumps are built in four sizes as follows, and enquiries should be addressed to The Ingersoll-Rand Co., Ltd., 165, Queen Victoria Street, London, E.C. 4.

Size.	Gals. P.M.	Piston Speed.	St Pipe. Inches.	Ex. Pipe. Inches.	Suct. Pipe, in.	Dis. Pipe. Inches	Floor Space.
7 × 6 × 13..	40	.. 43	.. 1	.. 1½	.. 8	.. 6	.. 7 ft. 0 in. × 2 ft. 0 in.
10 × 6 × 13..	40	.. 43	.. 1½	.. 2	.. 8	.. 6	.. 7 ft. 3 in. × 2 ft. 0 in.
12 × 8 × 13..	70	.. 43	.. 1½	.. 2½	.. 10	.. 8	.. 7 ft. 6 in. × 2 ft. 6 in.
14 × 10 × 18..	130	.. 45	.. 2	.. 3	.. 12	.. 10	.. 9 ft. 6 in. × 3 ft. 0 in.

Successful results are stated to have been obtained in the propulsion of a Fordson tractor by the use of a "rapid" suction gas producer, burning charcoal. This adaptation of the small gas producer to the driving of tractors was first successful in Australia, where about 25 are now in operation.

Petrol costs now 20 cents or 1s. 1½d. per gallon in the United States, but 2s. 11½d. in the United Kingdom, allowing for freight and for the difference in the American and Imperial gallon. It is alleged that this high price to British consumers is maintained by the "oil combine," which is considered to have shown consistent disregard of the public needs. A fuel expert, writing in the press, states that "in the last resort our only means of defence would seem to be the mass production of power alcohol from sources untainted by the combine."

In his annual report, Mr. EARL D. BAST, President of the American Sugar Refining Co., described in detail the effect produced on the price of sugar in the United States by the release of Government control, and presented valuable facts and figures connected with the activities of the raw and refined sugar markets. Incidentally he referred to the competition of direct consumption sugars, which "has undoubtedly stirred the refining interests to provide themselves with permanent sources of supply of raws." In addition to the Central Cunagua, Cuba, his company has under construction the Central Jaronu, capable of producing 600,000 bags, that is, about the same as Cunagua. It is remarked that if the labour supply of Cuba is maintained, that country may in time produce half the total world's demand for sugar.

Cause and Remedy of the Difficult Defecation of Cane Juice.

By CHARLES MULLER.

In order to determine the cause of the difficulty which one sometimes encounters in defecating cane juice, the variation of the amount of lime was studied, the behaviour of the juice towards this clarifier employed either alone or in association with sulphurous acid at different temperatures being observed.

It was concluded: (1) That while there are juices defecating perfectly with the usual amount of lime, there are also others which hardly defecate even when the amount of lime much exceeds the proportion employed in present-day manufacture; (2) that the faculty of defecating more or less well depends upon the purity of the juice, the conditions of temperature being equal; and (3) that the action of the sulphurous acid added before or after liming, cold or hot, simultaneously or separately with the lime, does not give appreciably different results.

These points being established, the cause to which one may attribute this particular phenomenon so prejudicial to manufacture was investigated, and the remedy that might be applied was examined. Since several suppositions, more or less plausible, arise, we proceeded by the method of elimination:

(a) The presence of acetates, lactates, and formates of lime. Analysis showed only traces of volatile acids in the juice, hence this supposition is eliminated.

(b) The imperfect constitution of the fibre, especially for young and undeveloped cane, an hypothesis also unjustified, since on analysing the bagasse after washing and drying, figures were obtained showing that there exists no relationship between the amounts of cellulose and gums, that these substances do not vary at all with the age of the plant, and that they do not appear to have any influence on the facility of the defecation of the juice, so far as normal cane is concerned. (c) The total quantity of soluble silica in the juice. Regarding this subject, we have made a large number of analyses of the ash of cane juice of varying age and development coming from different soils, grown with care and without, lightly and heavily manured, the figures per cent. carbonated ash being as follows:—

Total silica	2.10	Potash	43.65
Iron oxide	3.25	Soda	21.20
Alumina	1.30	Phosphoric acid	4.05
Lime	1.60	Sulphuric acid	6.10
Magnesia	1.80	Carbonic acid	13.85

The amounts of silica per litre of the juice did not vary very much from one juice to the other, as one may see from the following table:—

FIELD.	1	2	3	4	5	6
Year	First.	First.	Second.	First.	First.	Third.
Silica per cent., dry matter ..	0.021 ..	0.019 ..	0.025 ..	0.018 ..	0.020 ..	0.026
Defecation	bad ..	bad ..	easy ..	good ..	impossible ..	bad

Hence the influence of the silica, in so far as the total soluble silica is concerned, is not at all established. On following up this point, and on studying the solubility of this silica in the juice, and its behaviour towards the defecants used in manufacture, we have arrived at the following conclusions:—

(1) The silica of the juice is not always eliminated by the lime or sulphurous acid, and sometimes on the contrary forms soluble compounds with the lime. These compounds, into which probably organic matter enters, are capable of perfectly resisting the action of the maximum heat of the re-heaters, that is, 104–106° C. It is known that in the *Graminæ* in general the silica entrained by the upward movement of the sap is insoluble in alkalis at the commencement of

growth. Later, before maturity this silica becomes soluble, and again becomes insoluble when the plant arrives at maturity. This silica is not combined to the mineral bases of the plant (since hydrofluoric acid eliminates it completely), but possesses the faculty of being soluble in alkali bases at certain periods of the life of the plant.

(2) The silica of the juice appears to be combined in complex organo-silicious bodies of a colloid nature. In fact, comparative tests have proven that while the juices extracted by crushing in mills may neither defecate nor filter through paper, yet the juice from cane obtained by diffusion may defecate very easily, giving a liquid of perfect limpidity, passing rapidly through paper or cloth. Lime does not precipitate the silica from juice obtained by crushing in mills; but in the case of juice obtained by diffusion, the major part of this silica is precipitable by lime.

(3) The colloidal compounds for the greater part are destroyed by superheating. If one diffuses the bagasse obtained after double crushing, a juice which has a satisfactory purity, but which does not defecate or filter well, is obtained. If one admits as probable the presence of colloidal organo-silicious compound, it is easy to explain this phenomenon, for this compound does not pass through the walls of the intact cells of the cossettes, but easily passes into the juice after rupture of the cell by crushing in mills.

If unlimed juice be heated in an autoclave under a pressure of 0.80 kg., corresponding to a temperature of 116° C. (241° F.), the organic matter of the silica compound precipitates, and the juice resulting from the operation is decolorized probably by the destruction of the colouring matter anthocyanin, though it remains cloudy. After, however, adding a quantity of lime amounting to about one-third of the normal quantity, and heating to 100° C., this juice completely clarifies. The deposit formed by the slow decantation of a badly defecating juice contains very little silica, but contains 6-7 times more if the juice is superheated before liming. This demonstrates the destruction of the soluble colloidal compounds in the lime, and also that this base in this case becomes capable of precipitating the silica set free. Here are some figures illustrating this:

	Juice defecated by the usual method, limed, sulphited, and heated to 102° C.	Juice superheated to 116° C., limed, sul- phited at 80° C., and heated to 100° C.
Silica precipitated	0.46	1.02
Per litre of juice	0.30	1.40

In all these experiments on the superheating of the juice, we have found: (1) A perceptible diminution of the lime naturally existing in the juice which originates from the mineral matter of the cane. (2) A very slight increase of the glucose, which can probably be avoided by neutralizing the juice. (3) A very perceptible decolorization of the juice. (4) A remarkable rapidity of defecation after the addition of lime and reheating to 100° C.

CONCLUSION.

It results from this work that colloidal organo-silicious compounds exist in certain canes for reasons yet insufficiently defined, though plausibly explicable. These compounds are soluble in alkalis and alkaline earths at certain periods of the liming of the plant, but are insoluble at other periods. Living cells unruptured by crushing are impermeable to these compounds. This concerns healthy cane, unburnt, and unaffected by frost or by a long exposure to the sun after cutting.

These compounds, which act harmfully in defecation, and are strongly melassigenic, are for the greater part destroyed by the superheating of the juice to 116° C. (241° F.), the silica precipitable by the lime being set free, and the organic

Cause and Remedy of the Difficult Defecation of Cane Juice.

matter coagulated. Moreover, whereas the gums are not eliminated in ordinary defecation, and contribute a good deal to the fouling of the quadruple effect, and to making the low-products viscous, these matters are completely precipitated by the superheating of the juice. Under these conditions, the lime added to the juice after superheating may be diminished to about one-third of the usual quantity without inconvenience, leading also to an economy of sulphur.

It may be remarked that the process which we recommend is a modification of that of DEMING, which consists in liming the juice and heating for 1 min. to 120° C. (248° F.). Numerous experiments have shown us that for the cane with which we are concerned this method of operating gives hardly any result, the juice leaving the apparatus strongly coloured. Destruction of glucose takes place, and the silica is not eliminated at all. It is therefore necessary to superheat before the addition of the lime, and if later the syrups and molasses are also sulphited the maximum effect is obtained. On superheating under a pressure of 1 kg. the molasses from the centrifugals, and sulphiting them after cooling to 60° C. (140° F.), a very fluid product was obtained with a considerable deposit consisting of lime, silica, and organic matter.

American Commerce Reports.¹

SPECIAL SUGAR PRICES TO AUSTRALIAN FRUIT PRESERVERS.

The present wholesale price of sugar in Australia is fixed at £46 1s. 6d. a ton as the result of the action of the Australian Government in March, 1920, guaranteeing a price of £30 6s. 8d. for all Queensland raw sugar for three years. The price fixed for refining is £6 2s. 6d. per ton, and the retail price is 6d. per lb. All transactions in sugar are regulated by the sugar comptroller, an official of the Prime Minister's Department. The sugar crop of Queensland this year is expected to total 300,000 tons, a very considerable increase over the recent crops, though not much in excess of the 1917-18 crop. This amount in conjunction with a probable production of approximately 20,000 tons in New South Wales, the second important sugar State of Australia, will undoubtedly fill the requirements of that country. Realizing that such high prices for sugar would make the cost of jams and canned fruits produced in Australia so high as to exclude them from foreign trade, the Government gives a rebate of £20 a ton to jam makers and canners for such sugar used by them as has been exported in jam and tinned fruits. The preservers, however, allege that this concession does not put them on an even basis with foreign manufacturers, as the Australian price of sugar, even with the £20 rebate, is above the world's parity. Accordingly the Government recently agreed to let them import their own sugar and manufacture in bond, duty free. The jam makers claim that it is now too late to import sugar in time to sweeten this season's fruit crop, and have asked the Government to advance them sugar against their imports; that is, to let them have what sugar they need now and let them replace the sugar instead of buying from the sugar administration at £46 1s. 6d. with the £20 rebate, but it is quite problematical whether this request will be granted. The sugar administration has been trying to average down the price by importing Cuban refined sugar, but admits that the effort has not been sufficiently successful to justify a reduction in the wholesale nor in the retail prices.

The facts that the guaranty remains effective for some time to come, that this year's crop fully meets Australian requirements, and that the Australian price is so much above the world market price, are all serious obstacles to such a programme for scaling down the price.

¹ Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

Although the sale of sugar to jam manufacturers and canners for export at £26 1s. 6d. is causing the Government considerable loss, it has been further proposed for the Federal Government to guarantee jam factories generally on unsold surplus stocks, but it is doubtful if such a proposal will be adopted, for, in addition to the objections to this particular guaranty, there is a still greater objection in that the granting of such a proposal would create a precedent which would make it difficult, if not impossible, to refuse the wool people, wheat growers, meat packers, and many other industries who are urging the Federal Government for similar guarantees, and that at a time when the Government is finding it a difficult problem to meet its existing obligations.

The State of Victoria has already advanced considerable sums to one of the local fruit-preserving companies, and probably will continue to assist jam makers as much as possible, but the motive is more to assist the fruit growers of Victoria rather than the canners, for the only salvation for the fruit growers, who are in difficult straights, seems to be in keeping the canneries in operation. It is possible that Tasmania may adopt a similar programme to assist the fruit growers of that State.

ARGENTINE SUGAR STATISTICS FOR 1920.

The Director of Rural Economy and Statistics recently presented to the Minister of Agriculture a report on the production of sugar in Argentina in 1920. The figures are as follows:—

PROVINCES.	CANE GROWN METRIC TONS	SUGAR PRODUCED. METRIC TONS.	YIELD. PER CENT.
Tucuman.. .. .	2,499,636	165,008	6.6
Jujuy	350,565	28,939	8.2
Santa Fe.. .. .	158,521	10,394	6.5
Salta	61,281	3,586	5.8
Corrientes	8,602	559	6.5
Chaco	21,115	1,167	5.5
Total	3,099,722	209,653	6.7

The same official reports that, in an area of 95,000 hectares (234,749 acres) planted to sugar cane, the return in sugar has been 2207 kilos per hectare (1969.5 lbs. per acre).

The report points out that the entirely abnormal circumstances that have disturbed the sugar trade since 1915 make it practically impossible to determine the alternatives that the restricted consumption has undergone as a result of the scarcity and the corresponding high cost of sugar.

The following table shows production, importation, exportation, and surplus since 1915:

YEAR.	PRODUCTION. METRIC TONS.	IMPORTATION METRIC TONS.	EXPORTATION. METRIC TONS.	SURPLUS. METRIC TONS.
1915 ..	149,299	23	53,823	95,499
1916 ..	84,069	30,326	404	113,991
1917 ..	88,075	160,157	32	248,200
1918 ..	125,950	33,269	9	159,210
1919 ..	297,646	82,138	1,453	378,331
1920 ..	209,653	—	81,813	127,840
Total....	954,692	305,913	137,534	1,123,071

According to the preceding figures, the stock of sugar in the Argentine market within this period of six years amounted to 1,260,605 tons, of which approximately 76 per cent. represented production and 24 per cent. represented imports. Of this total, 1,123,071 tons (89 per cent.) went to domestic consumption, while 137,534 tons (11 per cent.) went to exports.

This proportion gives an annual average of 187,178 tons for domestic consumption. Admitting a minimum of 210,000 tons for domestic consumption in the year 1915, and taking into account the increase of 8.1 per cent. in the population since that year, the quantity necessary for domestic consumption during the year 1920 would have been 227,010 tons, and the annual average for the period indicated does not exceed 187,178

American Commerce Reports.

tons. It is necessary, therefore, to establish the annual average or proportion in order to understand at once that the consumption of sugar has notably diminished.

It is not possible to fix mathematically the annual consumption of sugar *per capita*, because the terms of the formula will be variable; but it is a universal rule in these cases to adopt an average as established by the facts during a long series of years. Both by official statistics and by experts in the sugar industry, an average of 26 kilos (57.3 lbs.) *per capita* has been established.

Upon this basis and upon that of the official demographic data, we would have the following result for a normal consumption:—

YEAR.	POPULATION.	CONSUMPTION. METRIC TONS.	PRODUCTION. METRIC TONS.
1915	8,248,530	214,461	149,299
1916	8,350,066	217,101	84,069
1917	8,468,026	220,169	88,075
1918	8,611,204	223,891	125,950
1919	8,768,374	227,978	297,646
1920	8,979,821	232,475	209,653
Total		1,337,075	954,692

For the purposes of these estimates, immigration and emigration are calculated upon the basis of the first three months of 1920.

The figures prove previous observations with regard to the diminution that the consumption of sugar has undergone in this country. [Consular Report, July, 1921.]

THE FRENCH SUGAR INDUSTRY.

Owing to the fact that the French sugar factories are located principally in the devastated regions of France, and that a large proportion of them have been totally destroyed, it is impossible to ascertain precisely how many factories are owned by planters, how many owned by corporations, or how many partly owned by planters. Factories not belonging to planters have, nevertheless, direct interests in beet cultivation and produce beets used in their factories in a proportion varying from 5 to 50 per cent. of their total requirements.

According to official statistics published in the *Journal Officiel* of July 17th, 1921, during the period September 1st, 1920, to June 30th, 1921, there were 72 French sugar factories which shipped 313,975 metric tons of sugar, as compared with 60 factories which shipped 160,897 tons during the same period of the season 1919-20. Prior to the war, in 1912-13, there were 213 factories working, which produced a total of 864,815 tons of sugar.

There are no Government-owned sugar factories in France, and the Government does not intervene either as regards the method of the cultivation of beets or in respect to choice of seeds, fertilizers, etc. The planter as sole owner of a sugar factory is seldom to be found, and even though his name may be given to the factory, he usually has partners who subscribe to a part of the capital employed. The capacity of French factories ranges from a maximum of 4000 tons of beets to a minimum of 125 tons per day.

Contracts between planters and factories, mostly holding good for one year, are usually made between October and March; but there are beet producers who make contracts on an eight to ten year basis.

To provide the necessary capital for reconstruction of sugar factories destroyed during the war, a number of leading firms in the industry have issued a collective loan for 200,000,000 francs, the proceeds of which will be divided among the firms guaranteeing the issue. To assure payment of interest and repayment of the bonds, each of the interested parties mortgages to the syndicate reparations payable by the French Government for damage done during the war. [Consular Report, August, 1921.]

The importance of the chocolate and biscuit industry in Italy, says a U.S.A. Consular Report, has greatly increased, both as regards the building of new establishments and the quality of the products, which has reached such excellence as to bear favourable comparison with the best foreign makes. The capital now invested in this industry is more than ten times greater than it was before the war, and the number of workers employed, which before the war was 10,000, is at present 50,000. There are projects for new companies and enlargements of the present establishments.

Publications Received.

Industrial and Power Alcohol. R. C. Farmer, O.B.E. (Sir Isaac Pitman & Sons, London, Melbourne, and New York.) 1921. Price: 2s. 6d.

Dr. Farmer's small book will be found serviceable by those desiring to acquire a general insight into the increasingly important question of power alcohol. It has been quite skilfully compiled from the large amount of literature which has been produced during recent years (most of which has been noticed in the columns of this *Journal* from time to time); and the result is a useful little handbook on matters such as the production of alcohol; its denaturation; possible sources of its raw material; and its utilization for power purposes. These matters are in general allocated space commensurate with their importance. Excise restrictions which seriously impede the production and sale of alcohol for use as a fuel in this country also receive fair consideration, such for example, as the prohibition of brewing and distilling simultaneously; the use of the saccharometer as prescribed by the Act of 1880; the refusal to permit transport by tank-wagons; and the insistence of costly methods of denaturing. However, after reading the portion of the book dealing with such matters, one is given the impression that Dr. FARMER had in his mind only the requirements for the production of spirit in this country. Regulations and conditions which should govern the importation into this country of denatured alcohol from countries where it can be produced from prolific raw materials at a very low cost appear to have escaped his consideration. Home distilleries may supply a certain amount of industrial alcohol from imported molasses, and possibly from some home-grown raw materials, but the bulk of our future supplies of power alcohol will surely be imported directly from tropical or semi-tropical countries overseas for the purpose, in the words of Sir WILLIAM POPE,¹ "of utilizing the surplus energy of the tropics in supplementing the waning supplies of energy available in colder climates."

Report of the (Indian) Industrial Alcohol Committee, 1920. (Superintendent of Government Printing, India, Post Box No. 95, Calcutta.) 1921. Price: 10s. net.

German Grammar for Science Students. W. A. Osborne, M.B., D.Sc., and Ethel E. Osborne, M.Sc. Third Edition. (Sir Isaac Pitman & Sons, Ltd., London, Melbourne, and New York.) 1919. Price: 3s. net.

This is among the best and most practical of the many German grammars which have been published for science students. It is not intended to enable the student to converse in German. In writing it the purpose of the authors has been to place in the student's hands a grammar which will teach him to *read* scientific articles and treatises in the German tongue; and rules, lists of exceptions, etc., concerned more with the study of composition than with the translation are deliberately omitted. We think that after having mastered the contents of this book, and having selected a good dictionary (such as Dr. Patterson's²) a student should be able to read with some fluency the journals and books concerned with the particular branch of science or industry in which he is interested.

Engineers' and Erectors' Pocket Dictionary: English, German, and Dutch. By W. H. Steenbeek. (Sir Isaac Pitman & Sons, Ltd., London, Melbourne, and New York.) Price: 2s. 6d.

English and American engineers will find this a useful dictionary. It has been compiled by one who has been engaged in installing machinery in different countries; and includes, in addition to the more commonly occurring words, a number of technical terms and phrases which are not generally included in similar pocket-books.

¹ Presidential Address to the Society of Chemical Industry, delivered at Montreal, 1921.
² *I.S.J.*, 1921, 168 and 528.

Brevities.

Mr. E. WUTNRICH, well-known in Natal and Zululand as technical advisor to a number of different factories, has been appointed the general representative for British South Africa of the Sugar Machinery Manufacturing Co., Ltd., London.

A patent¹ has been taken out for the use of adsorbing (decolorizing) carbon for producing a vacuum in the jackets of storage tanks. Carbon prepared by heating wood which has been impregnated with salts, such as zinc chloride, is recommended.

The Swedish Rikstag has prolonged the law relating to the maximum price and import monopoly on sugar for another 12 months. Both the import of sugar and the sale of the indigenous product is to be carried out as before by the Swedish Sugar Factories Co.

In the recent article on Dr. Spencer's improved electric oven for the rapid determination of moisture in sugars², it should have been mentioned that the makers of this useful apparatus are the ARTHUR H. THOMAS Company, West Washington Square, Philadelphia, U.S.A. (See page xl.)

A continuous centrifugal machine of the "ter Meer" type has recently been found satisfactory for the drying of sewage mud.³ Its capacity amounts to 4-9 cub. metres of crude mud per hour, corresponding to about 700-1600 kg.; its power consumption is 12-16 H P. at 900 revs. per min.; while its cost of maintenance and of operation are said to be moderate.

A. MAILHE,⁴ in a paper read before the Academie des Sciences, Paris, pointed out that when linseed oil is passed over a mixture of electrolytic copper and magnesia at 550-650°C. and the more volatile products hydrogenated, a mixture of aromatic and cyclic hydrocarbons is obtained, which may be separated into a burning oil and an artificial petroleum spirit of sp. gr. 0.760, suitable for use as a motor fuel.

Dr. J. J. WILLAMAN, of the University of Minnesota, St. Paul, U.S.A., stated⁵ that the sorghum syrup industry has gained new impetus through certain improvements, namely: (1) the breeding of improved varieties; (2) the use of a cleaning machine which removes the seed heads, separates the leaves from the stalks, and provides thus a juice of fairly uniform composition; and (3) the filtration of the entire juice through cloth after treatment with lime and heat and the addition of kieselguhr.

Investigations carried out by C. L. CLAREMONT, chemist to the Rat Destruction Department, Ministry of Agriculture, London,⁶ show that the virus method is uncertain. "Gassing" with sulphur dioxide is effective, especially as it kills the females and their young in their nests. Among the poisons which are not dangerously toxic to other animals, but are deadly to rats, are barium carbonate and red squill (*Scilla maritima*); and these should be made into baits by means of the formulæ previously described.⁷ Baits having no odour should be slightly flavoured with aniseed.

In regard to the manufacture of "Natilite" motor fuel in tropical countries, a point frequently raised concerns the condensation of the ether, produced by the action of sulphuric acid on alcohol, as recently explained in these columns.⁸ Ether boils at 34.6°C., but the temperature of the factory water may reach 90°F. (32.2°C.). Under these conditions it has been found most economical and practicable to condense as much ether as possible in the ordinary cooler, the vapour escaping being condensed in a second cooler supplied with water at a sufficiently low temperature from a refrigerator. A comparatively small refrigerator equipment should be found sufficient, and its installation should be an inexpensive addition to the plant. A "Natilite" factory also finds it advantageous to operate at its full capacity during those months of the year when the temperature is not at its maximum height.

¹ English Patent, 165,675.

² I.S.J., 1921, 333.

³ *Eng. Incer. ny Progress*, 1921, No. 2, 46-47.

⁴ *Comptes rendus*, 1921, 173, 358-359.

⁵ At the Meeting of the Section of Sugar Chemistry and Technology of the American Chemical Society, New York, September, 1921.

⁶ *J. Soc. Chem. Ind.*, 1921, 40, No. 17, 327-328.

⁷ I.S.J., 1920, 551.

⁸ See I.S.J., 1921, 391.

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DISTANCE BETWEEN THE MILLS AND THE EFFICIENCY OF MACERATION. *W. P. Ebbels. Bulletin de la Société des Chimistes de Maurice, 1921, 13, No. 43, 11-13.*

Present day practice in the design of milling plant tends more and more towards the driving of two or more mill units by one engine through suitable gearing, an arrangement that necessitates the units being placed so near to one another that the maceration water remains only a very short time in contact with the bagasse before being squeezed out by the next mill of the train. An attempt was made by the author at the Beau Séjour factory, Mauritius, to obtain an answer to the question whether under the new conditions maceration is as efficient as when the mills are driven by separate engines and placed far enough apart to allow the water to remain in contact with the bagasse much longer. The plant used consisted of a Krajewski crusher and three 3-roller mills, each driven by a separate engine, the distance from the centre of the first to the second being 47 ft., and from the second to the third 44 ft., while the bagasse took about 4 min. to travel from one mill to the next. In the factory mentioned, the regular practice is to spray water on the bagasse leaving the second mill, and the diluted juice from the third mill upon the bagasse as it leaves the first. In order to imitate as closely as possible the new conditions of a short distance between the units, the water was sprayed on the bagasse in the feed shoot of the third mill about 4 ft. from the mill mouth, and the diluted juice upon the bagasse in the feed shoot of the second mill at about the same distance as in the other case, the following figures being obtained:

	CANE.		BAGASSE.		MACERATION.	
	SUCROSE.		SUCROSE.	MOISTURE.	PER CENT. CANE.	
Ordinary practice..	15.14	....	2.80	....	41.6	.... 26.3
New condition ..	15.13	....	3.52	....	41.8	.... 27.0

Further, during these trials samples of juice were taken from the back and front of the second and third mills. It was concluded from these trials that maceration under the new conditions of a shorter distance between the units does not appear to be as efficient as in ordinary practice for the following reasons: (1) More sucrose is lost in the bagasse; (2) the Brix of the diluted juice from the front roller of the third mill is lower, and the difference between the Brix of the juice coming from the front and the back rollers is greater at both mills, indicating a less complete admixture; (3) the difference between the purity of the juice from the back and that from the front roller of the third mill was much greater. It is, however, difficult to say from these results whether the inferior results and less complete admixture under the new conditions are entirely due to the water and diluted juice being in contact with the bagasse a shorter time, or in part to the fact that both were sprayed upon the bagasse when it was lying loosely upon the feed shoot, whereas in ordinary practice both are sprayed upon it as near the top roller as possible while it is still more or less compressed. To finally decide this point a comparative trial would have to be made with the present installation at Séjour, and also with a plant in which the mills are driven by a single engine, and consequently placed much closer together.

CONTINUOUS SAMPLING OF SUGAR JUICES, ETC. *Walter L. Jordan. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 7, 640-641.* (Paper read before the Section of Sugar Chemistry and Technology at the 61st Meeting of the American Chemical Society, New York, 1921.)

Methods now used for sampling liquids automatically all give (as far as the writer is aware) a sample the volume of which is dependent upon the time element and bears no relation to variations in flow of the liquid sampled. Thus if a drip sample is taken, a small flow through the main pipe line adds just as much to the sample as a large flow; and if at the same time the composition of the juice varies, it is evident that such a sample cannot be representative of the total juice flowing. A sample proportional to the total

¹ This Review is copyright, and no part of it may be reproduced without permission.—(Editor, I.S.J.)

Review of Current Technical Literature.

flow may be obtained by the circular weir shown in Fig. 1, the sample being that portion overflowing through the vertical slot. This device can be applied wherever the liquor to be sampled flows into a receiving tank, measuring tank, defecator, etc. Instead of the juice or liquor running into the tank through a downward turned nipple or fitting, this is turned up so that the pipe fills and the juice spills over the level edge of the fitting. The size of the sample obtained is dependent approximately on the relation between the width of the slot and the total weir circumference. Actually, the sample will be smaller than indicated by this proportion, on account of the fact that the sides of the slot restrict the

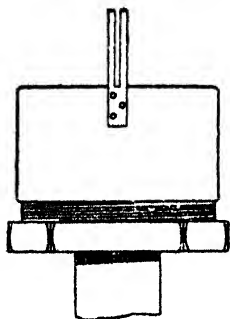


FIG. 1.

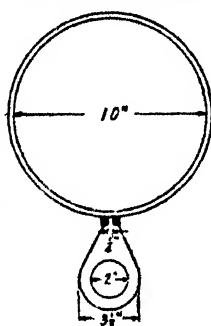


FIG. 2.

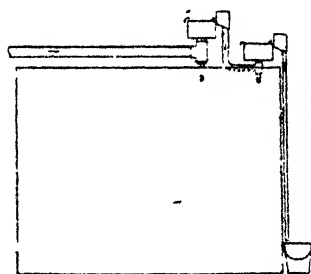


FIG. 3.

flow somewhat. The depth of flow is the same, however, for the slot and for the balance of the circumference. A weir 10 in. in diam. with a 0.25 in. slot in a 1 in. wide plate will give a sample of about one one-hundred and twentieth of the total liquid flowing; or with an 0.125 in. slot, one two-hundred and fortieth. Fig. 2 illustrates the relation between the width of the sample slot and the total weir. A funnel constructed of light sheet metal and soldered to both sides of the slot plate serves to carry off the sample. If the volume of liquid is very large, it may be necessary to reduce it twice, as in Fig. 3. In a mill grinding 2000 tons of cane per day, the juice may thus be reduced to a bucket sample per 6-hour shift. Drainage cocks are indicated to empty the pipe lines at shut-downs. The sampler can be made up in any mill shop of standard pipe fittings.

PROBLEM OF THE DISPOSAL OF SURPLUS BAGASSE IN THE PHILIPPINES. *R. Renton Hind. Sugar News, 1921, 2, No. 6, 219-222.*

A familiar sight at factories in the Philippine Islands is a mountain of bagasse, the disposal of which is a problem when insurance policies require that no inflammable material should be found in the immediate vicinity of the buildings. This surplus of bagasse results from the short milling season imposed by the local weather conditions, the central being generally compelled to operate above its rated capacity, so that to produce a juice of high density the dilution is kept down to about 15 per cent. or less. Mr. RENTON HIND discusses the possible means of disposing of this material. It might of course be made into paper and millboard, but this means the erection of a pulp mill, entailing a heavy investment. It might be burned under extra boilers for the generation of electricity for plantation railways, or for the pumping of irrigation water. Or again, it might be spread upon fallowing fields, in order in this way to return to the land some of the soil nutrients removed during the growth of the cane. However, at the immediate moment the best means of utilizing at any rate a proportion of it appears to be to form it into bales for burning at the beginning or the end of the season, at which periods there is always a need for extra fuel. A horizontal hay-press making bales 16 in. \times 18 in. \times 30 in., each weighing about 45 kg., has been found to give satisfactory results, and with 20-25 H.P. from 50 to 60 bales may be turned out per hour at about two centavos per bale. An illustration is given of a type of horizontal machine which bales continuously, and is easily and rapidly operated.

ROTATION IN SUGAR DEGREES OF THE NORMAL WEIGHT SOLUTION OF THE SACCHARIMETER.

Vlad. Stanek. *Listy cukrovarnické*, 1920-21, No. 45; *Zeitsch. Zuckerind. oöcho-slovak. Republik*, 1921, 45, Nos. 49 and 50, 417-423, and 425-431.

Saccharimeters at the present time are standardized according to the value established by HERZFELD¹ and SCHÖNRÖCK,² namely, that 34·657 circular degrees when using spectrally purified sodium light correspond to 100 degrees on the sugar scale at 20°C. Subsequent to the date of this important work, viz., 1904, quartz plates based on the standard stated were despatched to different countries for the calibration and the verification of saccharimeter scales. However, it has been observed by certain chemists, notably by BATES and JACKSON,³ that the normal sugar solution obtained by the solution of 26 grms. of pure sucrose in 100 metric c.c. of water really reads less than 100°S., and that in consequence the standard established by the German workers is inexact. Mr. STANEK working at the Prague Experiment Station now again verifies the existence of this discrepancy. He used a Bates-Fric saccharimeter, in which the half-shadow angle may be varied from 2·5 to 15°, and therefore the sensibility adjusted for different conditions of observation. This instrument was illuminated by a half-watt 110-volt, metallic filament, frosted bulb lamp with the current at 120 volts, this over-voltage giving a very intense light similar to that of an Auer lamp. All observations were conducted in a chamber the temperature of which was 20·0°C., with variations of only 0·5°C.; while the temperature of the water passing through the jacketed polarization tube was controlled at 20°C. within 0·02 to 0·03°C. Weights, measuring flasks, and polarization tube were calibrated with the utmost care, and the error in the case of each was exactly determined.

Regarding the methods of preparing the pure sugar for such investigations, that proposed by the British chemists at the 1900 conference⁴ is considered to be too indefinite, since the concentration of a "hot saturated solution" may vary much, and hot saturated solutions anyway are difficult to filter. Herzfeld's method⁵ was tried, but abandoned on account of the slow filtration of the viscous sucrose solution in the cold, besides which 96 per cent. alcohol on being added to the cold saturated solution does not precipitate the sugar within 15 minutes as stated. Satisfactory results were obtained by dissolving two parts of sugar in one of water with the addition of a trace of ammonium carbonate, adding 1½ part of 96 per cent. alcohol, heating to boiling, and quickly filtering through a Buchner funnel dressed with smooth thick paper (S. & S. hardened), and preferably using the vacuum pump. The clear filtrate was treated with a further 1½ part of 96 per cent. alcohol, and cooled in flowing water, some "seed" being added, and the flask continuously agitated by some suitable mechanical arrangement. After 2-3 hours, the sugar precipitated was separated in a centrifugal machine (preferably that described by HERZFELD for the determination of the grain of raw sugars⁶) at 3000 revs. per minute for 10 minutes, the crystals being washed with 96 per cent. alcohol, and again spun for five minutes, which washing operation was repeated three times. Sugar thus obtained consisted of fine regular crystals and contained 0·2 to 0·5 per cent. of moisture, which was removed by spreading out the crystals on filter-paper and placing in a desiccator at 25 to 30°C., a yield of 60-70 per cent. of a product containing 0·01 to 0·05 per cent. and 0·001 per cent. of ash of moisture being finally obtained.

We come now to mention the quartz plates with which the normal solutions prepared from this pure sugar were compared. These were three in number: (A), which had been furnished by the firm of J. & J. FRIC, and had an index of 99·47°, and was marked Nr. 614; (B), which had been made by PETERS, of Berlin, had been tested in 1899 by the Reichsanstalt at the request of the International Commission, had been further examined by HERZFELD, and had also been used by SCHÖNRÖCK in the establishment of the conversion factor,⁷ its index being 100·05° according to HERZFELD, and its distinguishing mark Nr. 10·99; and lastly (C), which had also been made by PETERS, and had been

¹ *Vertragszeitschrift*, 1900, 882.

² *Ibid.*, 1904, 521.

³ *Sci. Paper, Bur. Standards*, No. 268; *I.S.J.*, 1917, 380.

⁴ International Commission for Uniform Methods of Sugar Analysis, held in Paris, July, 1900.

⁵ *Vertragszeitschrift*, 12, 71.

⁶ *I.S.J.*, 1912, 233.

⁷ *Vertragszeitschrift*, 1904, 521.

sent to Prague by Prof. HENZFELD, its index being 99.12° , and its mark Nr. 6.1. These three plates were first polarized in the saccharimeter, and the average error of the instrument thus determined; then normal solutions of 12 samples of sugars purified in the manner above indicated, and also the normal solutions of five samples of refined sugars (all carefully analysed), were observed, corrections being made for the small amounts of moisture, ash, and invert sugar (using Kraisy's new method¹), as well as for the error of the flasks and tube.

As the net result of this work, it was concluded that the polarization of the normal solutions of the purest refined examined (after making the corrections indicated) was 99.917° ; of the refined purified by once precipitating with alcohol, 99.904° ; and of refined purified by precipitating several times with alcohol in the manner above described, 99.81°S , in which latter case there was a very good agreement when cane and beet sugars were used. These figures average slightly lower than those obtained by BATES and JACKSON,² namely 99.895°S , and in general they confirm the work of the American chemists. Therefore, it is certain that much remains to be done towards establishing a correct standard, and it is urged that others should now engage in this investigation.³

TEMPERATURE OF INVERSION IN THE DOUBLE POLARIZATION (CLERGET) METHOD. *Eduard Freibauer. Zeitsch. Zuckerind. czechoslovak. Republik, 1921, 312, No. 40, 312.*

KOYDL stated in one of his papers⁴ that in determining the sucrose content of beet molasses by the double polarization method, it is unnecessary when inverting by means of hydrochloric acid to hold closely to the temperature prescribed by HENZFELD, namely, $67-70^\circ\text{C}$. A number of experiments carried out by the author confirmed this, as the following results (among others) showing the temperature of inversion, and the sucrose per cent., indicate: 69°C ., 47.75; 76°C ., 47.68; 80°C ., 47.68. Following this another series of tests were made: (a) in which the temperature of inversion was held at 69°C . during five minutes; and (b) in which the flask containing the solution to be inverted was placed in a water-bath at about 90°C ., the flame removed, and heating in this way continued for 10 minutes. Practically identical results were obtained with both methods of heating, showing clearly that it is unnecessary to hold tediously to the temperature of 69°C . during inversion. Naturally the use of a water-bath at about 90°C . in the manner described is a very convenient method for routine work during the rush of the campaign. Of course, it is understood that these results relate to beet molasses, and do not hold for purer liquids, in which latter case quite different results may be obtained. Thus a solution of a second crop beet sugar having a purity of about 90°C . gave a sucrose content of 57.71 per cent. at 69°C ., but one of 57.19 per cent at 80°C .

NEW SYSTEM FOR THE MEASUREMENT OF THE COLOUR OF SUGAR PRODUCTS TREATED WITH DECOLORIZING CARBON. *V. Sazavsky. Lusty cukrovarnické, 1920-21, 209.*

Recognizing the irrational and inconvenient nature of the method of estimating colour by comparison with the tinted glasses of the Stammer colorimeter, KOYDL⁵ introduced his saccharan system, according to which 1° Stammer represents the colour produced by the solution of 4 mgrms. of Ehrlich's saccharan compound⁶ in 100 c. c. of water; but the disadvantage of this proposal is that the power of adsorption of char and decolorizing carbon is very much less towards saccharan than towards the colouring matters normally contained in beet liquors. Therefore, the author proposes the use of the nitrogenous substance isolated by STANEK, the so-called "fuscinic acid," the alkali salt of which is said to compose about half the colouring matter of beet molasses.⁷ By chance it happens that the colour of a solution containing 100 grms. of fuscinic acid in 100 c.c. corresponds almost

¹ I.S.J., 1921, 347.

² *Ibid* ³ Mr. STANEK points out the great advantage of an exchange of preparations of sucrose, of quartz plates, etc., among those taking up such investigations; and the services of the Prague Experiment Station as a neutral medium are offered for this purpose.

⁴ Österr.-Ungar. Zeitsch. Zuckerind., 1897, 503.

⁵ Österr.-Ungar. Zeitsch. Zuckerind., 1916, 123.

⁶ I.S.J., 1910, 84.

⁷ Zeitsch. Zuckerind. Böhm., 1916-17, 14, 298-306.

to 100,000° Stammer, so that 1 mgrm. in 100 c.c. = 1°S. Consequently, it is suggested that the amount of colour in sugar liquors should be expressed in terms of units of fusca-sinic acid, the advantage of this being: (1) that the conditions of practice are more closely approached; and (2) that calculation is simplified. STANEX proposes¹ to use the word "fusca" to denote the new unit, and one may thus have the mgrm., the grm. or the kg. fusca. *Example 1.*—In a refinery 42.5 quintals of "Carboraffin" were used for the decolorization of 58,000 hectol. of liquor, the colour being reduced from 3.48 to 1.65°S. Then the absolute colour content was $1.83 \times 58,000 = 106,000$ grm. fuscas, or 106 kg. f., which were adsorbed by 42.5 quintals or 4250 kg. Therefore, the "Carboraffin" had adsorbed $106 \times 100/4250 = 2.5$ per cent. f. *Example 2.*—A refinery works 1600 hectol. of washed sugar liquor daily, the colour of which is lowered from 2.5 to 1.0°S by the use of "Carboraffin." Further, the colour of 1000 hectol. of pilé liquor is also diminished in the same refinery from 15 to 10°S. by the use of "Carboraffin." In the laboratory the adsorption capacity of the "Carboraffin" was found to be 4.8 per cent. f.; and it is required to calculate the "Carboraffin" consumed. By the old Stammer system it would be almost impossible to do this; but it is simplified by the use of fusca units. Thus: $1.5 \times 1600 = 2400$ grm. f., or 2.4 kg. f., plus $5 \times 1000 = 5000$ grm. f., or 5 kg. f.; so that $2.4 + 5 = 7.4$ kg. f. is the daily colour to be removed. As 100 kg of "Carboraffin" remove 4.8 kg. f., therefore $100 \times 7.4/4.8 = 154$ kg. is the daily amount of "Carboraffin" required in the particular refinery concerned.

"NATILITE" IN THE FAR EAST. Carolyn Wilson. *Sugar News*, 1921, 2, No. 6, 227-230.

It is stated that the Natilite Motor Spirit Co. of Australia, Ltd., has acquired the rights for the production of alcohol-ether fuel in the Dutch East Indies, Straits Settlements, and the Federated Malay Straits. In the region around British North Borneo, Sumatra and the East Coast of Malay there are estimated to be two million acres of nipa palm suitable for the production of alcohol. It should be possible (the author states) in the Malay Straits to produce "Natilite" at 8 to 12 cents per gallon, and it could be sold at say \$0.40. About 250 gallons of alcohol are obtainable per acre of nipa palm, which matures in four to six years, and remains productive for another 50 years.

EXPERIMENTS ON THE DETERIORATION OF CANE AFTER CUTTING. R. C. Pitcairn. *Sugar News*, 1921, 2, No. 6, 223.

About 50 tons of cane was cut and divided into five lots, one of which was milled each day for five days, and the crusher juice sampled continuously. The average purity found on the five successive days was:—90.01; 88.82; 85.57; 82.06; and 80.73; and the boiling house recovery (calculated with the S. J. M. formula) 94.46; 93.57; 91.01; 88.01; 86.81. These figures show well the great importance of milling the cane as quickly as possible after it is cut.

REFRACTIVE INDICES OF SUGAR SOLUTIONS. (1) Hugo Krüss. *Vereinszeitschrift*, 1920, 617-525. (2) Hans Schulz. *Ibid.*, 1921, 347-359. (3) O. Schönrock. *Ibid.*, 1921, 417-420.

(1) A comparison of the tables of MATTHIESSEN,² MAIN,³ and SCHÖNROCK,⁴ stating the refractive indices of sucrose solutions at 20°C., was made by the author; and, based on a smooth-out curve obtained on plotting these values, a new table was constructed. The figures thus obtained differ only slightly from the corresponding values of Schönrock's table, though a little more in the case of Main's, especially in the higher concentrations. Following this, a comparison was made between (a) the values obtained by WIECHMANN⁵ for the refractive index and the dry substance by analysis, and (b) those stated in the tables by MAIN, SCHÖNROCK, and the author (from his smoothed-out curve). It was found that Main's, Schönrock's, and Krüss' values differed from Wiechmann's results on the average by 0.27, 0.19, and 0.14 per cent. respectively. Examination of the results also

¹ Private communication to Mr. SAZAVSKY.

² *Dissertation*, 1898.

³ *J.S.J.*, 1907, 481-487.

⁴ *Zeitsch. f. Instrk.*, 1911, 31, 191.

⁵ *Vereinszeitschrift*, 1908, 43, 1083.

Review of Current Technical Literature.

showed that while the greatest difference between any single refractometric observation and the direct analytical result scarcely amounts to 0.5 per cent., yet the mean of all the refractometric observations is only 0.1—0.2 per cent. higher than the direct dry substance determination. (2) In this second paper, it is considered doubtful by the writer whether the values for the refractive indices of sucrose solutions at 20°C. compiled by Krüss from the tables of MATTHIESSEN, MAIN, and SCHÖNROCK, are really the most reliable. (3) SCHÖNROCK points out that in his determinations the error was only about 1 unit in the 5th decimal place; whereas between his values and the new figures stated by Krüss the difference amounts to 4 units in the 4th decimal place.

SOPHISTICATED ULTRAMARINE BLUE. *Jaroslav Dedek. Listy cukrovarnické, 1920-21, 169; Zeitsch. Zuckerind. czechoslovak. Republik, 1921, 45, No. 40, 311.*

A sample of ultramarine blue was sent by a refinery to the Sugar Experiment Station, at Prague, with the complaint that its colour diminished in use, presumably under the influence of the slight alkalinity or the trace of hydrosulphite still retained by the crystals after washing. Microscopical examination showed it to be of fairly normal appearance, though in comparison with the best French ultramarines it had a more intense colour, which was not regularly distributed, many particles here and there being of a deeper shade than the surrounding material. Alcohol on being mixed with a little of it was coloured intensely blue, which solution was immediately decolorized on the addition of sodium hydrosulphite. At first it was thought this was a case of the substitution for the real article of so-called "artificial ultramarine blue" that is, an admixture of kaolin or similar material with an aniline dye; but on extracting the sample with alcohol, a blue residue was obtained. Finally, it was established that the sample was nothing more than a genuine ultramarine blue "improved" by the addition of about 1 per cent. of a spirit-soluble aniline dye.

MANUFACTURE OF STARCH, GLUCOSE AND BY-PRODUCTS. *R. H. Williams. Canadian Chemistry and Metallurgy, 1921, 5, No. 7, 195-196.*

A brief outline is given of the process, maize being used as raw material. Corn oil, extracted from the germ by means of a press, has recently come into considerable prominence as a soap oil. Its sp. gr. is about 0.92, and its saponification value 18—19.

IMPROVED FORM OF BARFORD'S SOLUTION. *H. E. Roaf. Proc. Physiol. Soc., 1920; J. Physiol., 1921, 54, ix-ixi.*

Experiments with reagents of varying composition lead to the acceptance of the following: copper acetate, 50 grms.; sodium acetate, 50 grms.; glacial acetic acid, 5 c.c.; water to 1000 c.c. With this reagent a reduction is obtained with 0.1 per cent. dextrose solution on merely heating to the boiling point; while 1 per cent. solutions of pure specimens of maltose or lactose do not show reduction under similar conditions.

VAPOUR PRESSURES OF MIXTURES OF 95 PER CENT. ETHYL ALCOHOL AND ETHYL ETHER. *L. J. Olmer. Bull. Soc. Chim., 1921, 29, 382-385.*

COMPOSITION OF THE GASEOUS PHASE OF ETHYL ALCOHOL-ETHYL ETHER MIXTURES IN TERMS OF THE LIQUID PHASE. *L. J. Olmer. Bull. Soc. Chim., 1921, 29, 385-389.*

LEVULOSAN. *Amé Picket and Joseph Reilly. Helv. Chim. Acta, 1921, 4, 613-616.*

INULIN. *H. Pringsheim and A. Aronowsky. Berichte, 1921, 54, 1281-1286.*

PREPARATION OF GALACTOSE. *E. P. Clark. J. Biol. Chem., 1921, 47, 1-2.*

J. P. O.

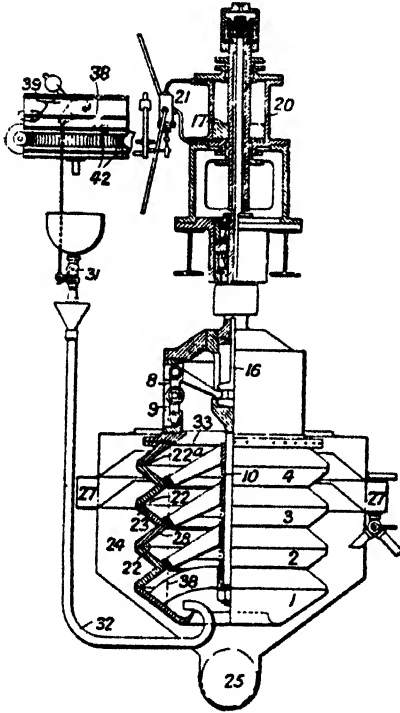
Review of Recent Patents.

UNITED KINGDOM.

CONTINUOUS CLARIFYING CENTRIFUGAL FOR SUGAR JUICES.² *Oliver Imray, of London* (communicated by *Wilhelm Mauss, of Johannesburg, Union of South Africa*). 164,418 (3474). February 4th, 1920.

According to this patent, a batch of mixture is treated in a centrifugal separator which separates fully the solids from the major part of the batch and partially from the remainder, the liquid, the fully separated solids, and the partially separated remainder

being separately discharged from the apparatus. The apparatus shown comprises a drum composed of a number of separable sections 1, 2, 3, 4, of conical form, which are pressed apart axially by springs 10 and are held together by a toggle-link 8, 9 which is controlled by a rod 16 movable axially by the piston 17 in a cylinder 20. The mixture is introduced through a pipe 32 and the solids are deposited in the spaces 22, 22a. The liquid escapes by way of the channel 33 at the upper end of the drum. After running the machine until a certain amount of solid is deposited in the chamber 22a, the supply is stopped and the drum sections separated. The fully separated solids escape to the chamber 24, and outlet 25, the partially separated solids and liquid in the chamber 22a escape to the launder 27 where they may be inspected and pass to either the chamber 24 or back to the supply vessel by way of the two-way valve 28. A slow-driven drum 38 is arranged to control the supply valve 31 and the discharging cylinder control valve 21 by means of tappets 39, 42 adjustably spaced in grooves on the drum 38. In the clarification of sugar juices, and in the case of a drum 2 ft. in diam., the speed is 1000-2000 revs. per min



CANE HARVESTER.³ *Max Wertheim, of Pietermaritzburg, Natal, Union of South Africa*. 164,229 (14,170). May 25th, 1920.

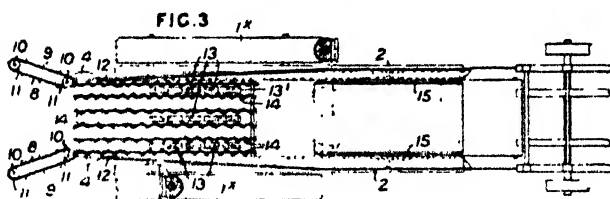
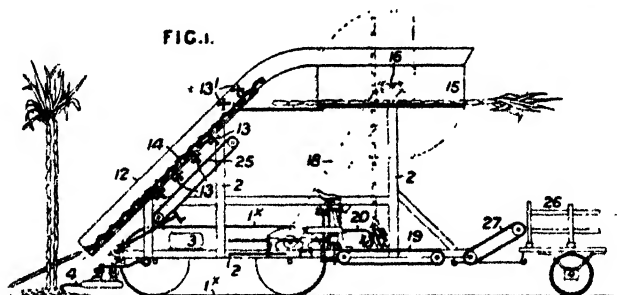
It comprises a main frame 2 supported on creeper chains or the like 1* and carrying rotary cutters 4, an elevator 12, discharging trough 15, and topping cutters 20. The canes are drawn to the cutters, which are mounted antifric tionally and may be adjusted in

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 26, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each) *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

² Experiments have been carried out by Messrs. REYNOLDS BROS., Ltd., at their Sezela factory, Natal, with the Mauss continuous juice clarifying machine; and Mr. E. CAMPDEN-SMITH, manager of the mill, has reported favourably on the results obtained. He states that, using this machine, 35-40 H P should be ample to operate the clarification department of a mill producing 100 tons of sugar per day. It is unnecessary here to emphasize the advantages such a system of operating (if economical and efficient) would have in comparison with the present mode of subsiding in tanks and filter-pressing the mud. See also U.K. patent, 133,448; *I S.J.*, 1920, 57.

³ This is the "Victor" cane cutter, described by Mr. JOHN MURRAY, M.I. Mech. E., as being "in advance of anything that has yet been invented." One of these machines has been shipped to South Africa for further trials by Messrs. DUNCAN STEWART & CO., Ltd., of Glasgow, who have acquired the patent rights. See also: *I.S.J.*, 1920, 411.

height, by chains 8 carrying hooked projections 9, the chain being mounted on sprocket wheels 10, 11 and driven from a prime mover 3. The cut canes fall into the conveyor 12 which is provided with helical brushes 14 and rotary brushes 13 to move the cane upwards and simultaneously to remove trash therefrom. Other rotary brushes 13¹ ensure the cane being delivered into one or more troughs 15 pivoted at 16 on the main frame. The trash falls on a conveyor 25 and is delivered into a receptacle or on to the ground. When sufficient cane has accumulated in the trough it is bound, and the trough turned through 90 degrees by giving motion to a belt 18. The cane falls top downwards and is topped by



a cutter or cutters 20 driven from the engine and movable on runners to cut through the bundle of cane. The tops are removed by hand or by a conveyor 19 which also delivers the topped canes to a second conveyor 27 which carries them to a trailer 26. After delivering the cane to the topping cutters the trough 15 is moved to its original position either by swinging back or by completing a revolution. Specification 156,298 is referred to.¹

PRODUCTION OF GLYCERIN FROM SUGAR PRODUCTS. *A. T. Cocking*, of Sutton Coldfield, and *C. H. Lilly*, of Edgbaston, Birmingham. 164,034 (23,644). September 25th, 1919.

Glycerin is produced by fermenting sugar solutions containing a mixture of about equal weights of alkali bisulphite and sulphite. The mixed sulphites may be added in successive small quantities to a proportion corresponding to the percentage of glycerin desired, the proportion of acetaldehyde and alcohol being greater the less the proportion of sulphites; and the liquid may be maintained approximately neutral by successive additions of alkali bisulphite solution or by increasing the proportion of bisulphite in the additions of the mixed sulphites. In an example in which the maximum glycerin yield was required, 311 gallons of a solution of raw sugar (equivalent to 788 lbs. of glucose) were fermented by 40 lbs. of yeast at a temperature of 35-37° C. for nine days, and during the first 5 days 176 gallons of mixed sodium sulphite and bisulphite solution (equivalent to 645 lbs. Na₂SO₃) were added in doses first of 40 lbs. and then of 30 lbs. of mixed salts in 16 gallons of water. In this way, 336 lbs. of glycerin, 172.2 lbs. of acetaldehyde, and 37.4 lbs. of alcohol were produced.

¹ I.S.J., 1921, 298.

EVAPORATION UTILIZING THERMO-COMPRESSION. *N. Testrup and Techno-Chemical Laboratories, Ltd., of Clapham Park, London. 163,793 (5,558). February 24th, 1920.*

According to this process of evaporation, the liquid is applied as a film on a moving surface, for example, on the outside of a hollow rotating drum, which dips into a bath of liquid in a closed casing or contacts with a feed-roller dipping into the bath. The vapours evolved are compressed by a pump to raise the temperature slightly, and passed to the inside of the drum to serve as heating agent. The outside of the drum is kept clean by contact with a revolving brush or a rubber or like scraper; while the scale which deposits may drop into a part of the bath separated by a perforated partition and may be continuously removed.

FILTER. *H. Plauson and J. A. Vielle, of Pall Mall, London. 155,834 (36,169). December 24th, 1920; convention date, July 5th, 1918; not yet accepted; abridged as open to inspection under Section 91 of the Act.*

A cylindrical or conical filter unit, applicable to extrusion presses or to plunger presses or as a suction drum, is formed by the superposition and compression of annular elements. These elements may be perforated plates or rings of wire mesh, or moulded rings of asbestos, cement, or gypsum, separated or reinforced by flat or corrugated metal or wire-work rings. Or the elements may consist of perforated cores or coils over which wire, that may have been previously wrapped with finer wire or yarn, is wound. A press is shown having a telescopic casing, in which a worm having a decreasing pitch towards the discharge end revolves; and in this press the filter element consists of thin plates with elongated slots, adjacent plates being arranged so that the slots of one are at right angles to those of the other.

MANUFACTURE OF INVERT SUGAR SYRUP (FROM DATES, ETC.). *F. Patterson, of Combe Down, Devon. 163,924 (16,322). June 16th, 1920.*

After heating the dates in a moist atmosphere at a temperature of 150-300°F. (65-6—148-9°C.), they are placed with water in a vessel, the upper part of which is narrowed to facilitate the removal of the scum arising during the process of extraction. After drawing off the liquor through strainers, it is run into settling tanks, where a preservative, such as salicylic acid, is added. Finally, it is passed through filter-presses, into tanks where it is concentrated to a density of about 1.24 (about 51° Brix).

RECOVERY OF POTASSIUM SALTS FROM DISTILLERY SLOPS. *Maurice Bird, of Berbice, British Guiana, 166,667 (10,282). April 13th, 1920.*

Waste heat produced in the factory is employed to effect the evaporation and charring of distillery slops. Preferably the slops are first neutralized with lime. They are next concentrated by passing them slowly over the heated flues leading from the furnaces to the factory chimney, and then poured into metallic pots. These are placed inside the flues to cause their contents to char. The residual mass has a content of phosphoric acid and nitrogen and is used as such as a manure, or the potassium chloride and sulphate may be leached out with water. Alternatively, the liquor concentrated as above described may be charred or incinerated by other means. [Reference has been directed by the Comptroller in pursuance of Sect. 7, Sub-sect. 4 of Patents and Designs Act of 1907 and 1919 to Specification 2524 of 1876.]

GERMANY.

PREPARATION OF A HIGHLY ACTIVE VEGETABLE DECOLORIZING CARBON. *Verein Chemischer Fabriken in Mannheim. 309,221. June 23rd, 1920.*

Wood in granular form is impregnated with solutions of electrolytes, as potassium hydroxide, carbonized at a moderate temperature, soaked in alkali, and the temperature finally raised to bright red heat.

UNITED STATES.

FILTER FOR SUGAR LIQUORS. *John J. Berrigan* (Assignor to *Henry R. Worthington Corporation*, of New York, U.S.A.). 1,360,292. August 24th, 1920. (Ten figures.)

(One important feature of the invention consists in a method of and an apparatus for preventing or reducing the adhesion of any slimy sedimentary material to the cloth sufficiently to form an obstructing layer. This desired result is attained by supplying a fluid to the interior of the hollow filter element during the filtering operation, so that as the sediment tends to accumulate on the outside of the filter element, its adhesiveness is counteracted and it either falls at once from the filter surface, or falls therefrom so soon as it has accumulated to an extent so slight as to be insufficient to materially obstruct the passage of the filtrate. In an apparatus embodying the preferred form of the invention, each filter element is of such a construction as to provide an interior compartment at least one of the walls of which, and generally both, constitutes a filter, this interior compartment being provided with an outlet as usual and also with an inlet for admission of the fluid whose function is to counteract the adhesiveness of the sediment which deposits on the outside of the filter element. It has been found that if, when filtering sugar liquors, steam is admitted continuously to the interior compartment of the filter during the filtering operation in the manner described, the sediment deposited on the outside of the filter cloths does not adhere to an extent sufficient to clog the filter, but drops off by its own weight and may be removed from the apparatus. This may be due to the heat of the steam, or to the pressure of the latter outward, or to both. Whatever the reason the action is very advantageous.)

EXTRACTION OF JUICE FROM BEETS, ETC., BY CRUSHING AND MACERATION.¹ *Oscar Mengelbier*, of Berlin, W., (Germany) (Assignor to *The Chemical Foundation Inc.*, of Delaware, U.S.A.). 1,372,891. March 29th, 1921.

Preliminarily the roots are cut into quite large slices, which pass successively up an elevator into a hopper, through a 2-roller mill or press with knurled or rifled surface, into a vessel or tank containing water, up an inclined transporter in which a revolving worm is mounted, through another vessel or tank containing water, and finally through another 2-roller mill or press, the surface of which is also roughened. Tests are said to have shown that this manner of operating combines the advantages of the ordinary diffusion with those of the new scalding or pressing processes, since the extraction is high, the slices are low in sugar, and the pressed pulp is high in dry substance. Moreover, the objectionable waste waters (the disposal of which is often such a difficult question) are entirely suppressed.²

CENTRIFUGAL MACHINE FOR SEPARATING SOLIDS FROM SUSPENSION IN LIQUIDS.³ *William J. Gee*, of Tulse Hill, London. 1,312,316. August 5th, 1919. (One drawing.)

EVAPORATION. *Jean C. Grière*, of Varese, Italy. 1,371,784. March 15th, 1921. (Ten drawings.)

Claim 1:—In an evaporator apparatus having two evaporating elements, a liquid conduit connecting the upper chamber of the first element with the lower chamber of the second element, a first separating means in said conduit having a return duct for vapours to said upper chamber of the first element, a second separating means provided in said conduit with a duct to the upper chamber of the second element for discharging vapours thereto separated from the liquid in said second separating means, the liquid residue being discharged through said conduit into the lower chamber of said second element, each of said elements comprising an upper chamber subdivided into a plurality of compart-

¹ See also French Patent, 470,880; *I.S.J.*, 1915, 148.

² This method of extracting beet juice with its two mills and its maceration therefore resembles in general principle that employed in cane milling.—*Ed.*, *I.S.J.*

³ See also U.K. Patents, 24,803 of 1911; 9365 of 1915; 106,689 of 1916; and 113,326 of 1917. Also *I.S.J.*, 1920, 377.

ments, a lower chamber similarly subdivided, rising tubes connecting similarly located compartments in both chambers, a heating chamber for said tubes provided with an inlet and an outlet for a heat supplying medium, a down pipe connecting one compartment in the upper chamber with a differently located compartment in the lower chamber and inlet and outlet pipes for the liquid in said lower chamber.

CUBE SUGAR PACKING AND BOXING MACHINE. *Richard Laborda*, of San Francisco, Cal., U.S.A. (Assignor of one-half to *John D. Spreckels, Jr.*, of San Francisco, Cal., U.S.A.). 1,367,821. February 8th, 1921. (Six drawings)

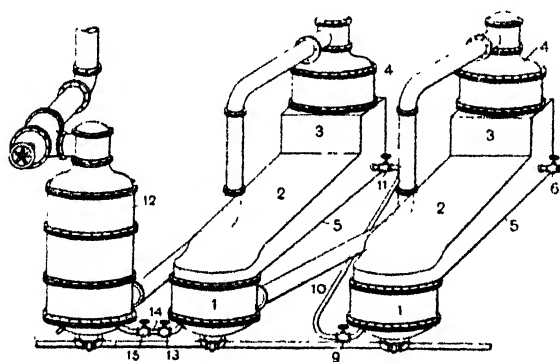
This invention relates to certain improvements on the construction shown in a previous specification.¹ It has for its object to provide means to facilitate the stacking of the cubes in assembled form; for supporting and transferring the assembled cubes to a receiving platform; for separating the stacked cubes into predetermined numbers or quantities for subsequently packing containers; and for filling or packing the containers with the sugar in an improved and efficient manner.

APPARATUS FOR THE CLARIFICATION AND EVAPORATION OF SUGAR JUICES. *Estéban Gorriti Aizcorve*, of Caibarien, Cuba. 1,358,132. November 9th, 1920. (Four figures.)

It is explained that the invention essentially consists in a modification of the apparatus usually employed for evaporating the water contained in the juice, so that the clarification of same and the evaporation of said water is performed at one and the same time, and continuously, the use of settling tanks being completely eliminated.

Substantially the design is to separate into two parts the evaporating apparatus employed until now. It comprises a lower chamber for heating the liquid and a superior

or upper chamber wherein the vacuum is applied, uniting both these chambers by means of a closed channel, as will be seen in the following description. Numeral 1, shows the heating chamber of the juice, which is to be purified. This chamber is constructed similarly to the body or lower chamber of any evaporator in use, and therefore it may be provided with a double bottom, or tubes, etc., for circulating



the steam. At the top of chamber 1 is bolted the channel 2, provided at the other end with a rectangular body 3, projecting upward to which is joined the body 4, which constitutes the vacuum chamber of the evaporating apparatus. The bottom 5 of the channel or conduit 2 is inclined and extends downwardly from the chamber 1 and adjacent to the lower end of the bottom of the channel 2 a valve 6 is provided for drawing in the juice to be clarified to flow into the channel until the chamber 1 is filled and the channel 2 a little above its middle.

When steam is applied to the heating chamber 1, the temperature of the liquid in it and in the channel 2 rises, and a circulation or current is established, flowing from the heating focus in the chamber, toward the other end of the channel, which this current drives back against the vertical wall, which is the limit of the channel 2, all the solid particles and foreign matter contained in suspension in the cold juice coming through the valve 6, re-uniting at this point not only the heavier substances but the lighter ones, and

¹ U.S.A. Serial, 294,886 of 1919.

Patents.

from thence they are removed by any convenient means (as e.g., through an opening) at suitable intervals. In the chamber 1, a pure and clear juice is found, free from all impurities because those contained in the cold liquid entering through the valve 6, are held back before arriving at the chamber by the flow of liquid resulting from the higher temperature of the liquid in the chamber 1 than in the channel 2. The heating of the liquid in the chamber 1 results in the boiling of the liquid and its flow from the heating chamber, the lighter particles being carried along the closed conduit toward the outer end by the foam on the surface of the liquid, while the heavier particles are carried downwardly and outwardly along the inclined bottom, which facilitates the movement of the heavier particles away from the heating chamber. This liquid now clarified and freed from much water is carried from chamber 1 through valve 9, pipe 10, and valve 11, to another similar chamber, in which it is submitted to the same operation, becoming purer, and losing more water. Lastly it is carried to the third evaporator 12 by way of the valve 13, pipe 14, and valve 15.

MOTOR FUEL CONTAINING ALCOHOL. *John P. Foster*, of Paia, Hawaii, T. H. 1,384,946. July 19th, 1921.

Claim is made for: (1) a motor fuel comprising a mixture of alcohol, ether, and anilin; (2) an admixture of ethyl alcohol, ethyl ether and anilin; (3) an admixture of alcohol, ether, kerosene, and anilin; and (4) an admixture of the following compounds in substantially the proportions (by volume) indicated: alcohol, 63; ether, 34; kerosene, 2; and anilin, 1 per cent.

CENTRIFUGAL PUMPS. *Jos. D. Cone*, (Assignor to *Ingersoll-Rand Co.*, of Jersey City, N. Y., U.S.A.) 1,385,115. July 19th, 1921.

ACTIVATION OF CARBON *John C. Woodruff*, of New York, U.S.A. 1,368,987. February 15th, 1921. (One drawing.)

Heretofore, charcoal has been activated by means of steam in vertical nichrome tube furnaces called "Dorsite" treaters; but the highest quality of absorbent charcoal is obtained only by running the material through at a very slow rate, or by re-passing it through several times. A more economical and rapid operation is secured by the apparatus here described. It is similar to a cement kiln in construction, and consists of a long slightly inclined cylinder, lined with fire-brick, and mounted on rollers. A charging device and outlet for the flue gases is provided at the high end, and a discharging device at the lower one. Hot flue gases, and also steam, air, carbon dioxide, are admitted into the revolving cylinder charged with carbon. It has been found that a temperature of 700-1000°C. gives satisfactory results in this apparatus, which gives a high yield of active material continuously with a moderate fuel consumption.

CENTRIFUGALS. (1) *Tandy A. Bryson* (Assignor to *The Tolhurst Machine Works*, of New York). 1,385,982. August 2nd, 1921. (2) *Meredith Leitch* (Assignor to *The De Laval Separator Co.*, of New York). 1,387,158. August 9th, 1921.

BEST-TOPPING ATTACHMENT FOR HARVESTING MACHINES. *Oliver P. Combest*, of Pomona, Calif., U.S.A. 1,379,530. May 24th, 1921.

CENTRIFUGAL MACHINE, WITH ELECTRIC DRIVE. *Edward D. Mackintosh* (*S. S. Hepworth Co.*, of New York, U.S.A.) Re-issue 15,115; original number, 1,342,405, dated June 1st, 1920.

DRIVE FOR GYRATORY CENTRIFUGAL MACHINES. *Eugene Roberts* (Assignor to *The Western States Machine Co.*). 1,383,567. July 5th, 1921.

MOUNTING AND DRIVING CENTRIFUGAL MACHINES. *Eugene Roberts* (Assignor to *The Western States Machine Co.*). 1,383,568. July 5th, 1921.

United States.

(Willatt & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920 Tons.
Total Receipts January 1st to September 29th..		2,041,438 ..	2,520,994
Deliveries		2,012,526 ..	2,509,756
Meltings by Refiners		1,964,844 ..	2,176,031
Exports of Refined		280,000 ..	325,000
Importers' Stocks, September 29th		39,964 ..	11,238
Total Stocks, September 29th.. .. .		117,153 ..	70,426
		1920.	1919.
Total Consumption for twelve months		4,084,672 ..	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

	(Tons of 2,240 lbs.)	1918-19. Tons.	1919 20. Tons.	1920 21. Tons.
Exports		2,782,443 ..	3,130,357 ..	1,898,821
Stocks		813,072 ..	327,032 ..	1,236,062
		<u>3,595,515</u>	<u>3,457,389</u>	<u>3,134,883</u>
Local Consumption		66,000 ..	62,700 ..	85,000
Receipts at Ports to August 31st		<u>3,661,515</u>	<u>3,520,089</u>	<u>3,219,883</u>

Havana, August 31st, 1921.

J. GUMA. — I. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR NINE MONTHS ENDING SEPTEMBER 30TH, 1913, 1920, AND 1921.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	668,058 ..	119,514 ..	381,150 ..	672 ..	2,500 ..	330
Raw	773,277 ..	920,353 ..	651,168 ..	3,116 ..	7,917 ..	2,266
Molasses	115,351 ..	57,833 ..	66,903 ..	238 ..	2,766 ..	455
	<u>1,555,686</u>	<u>1,097,700</u>	<u>1,099,221</u>	<u>4,026</u>	<u>13,483</u>	<u>3,051</u>
HOME CONSUMPTION.						
		1913. Tons.	1920. Tons.	1921. Tons.		
Refined		659,975 ..	137,665 ..	353,822		
Refined (in Bond) in the United Kingdom		546,479 ..	610,276 ..	589,917		
Raw		90,067 ..	155,198 ..	98,818		
Molasses		23,020 ..	22,800 ..	8,740		
Molasses, manufactured (in Bond) in United Kingdom ..		26,867 ..	56,574 ..	34,222		
Total		1,346,408 ..	982,513 ..	1,086,519		
Less Exports of British Refined		18,723 ..	688 ..	4,066		
		<u>1,327,685</u>	<u>981,825</u>	<u>1,080,553</u>		

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING SEPTEMBER 30TH.		NINE MONTHS ENDING SEPTEMBER 30TH.	
	1920. Tons.	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS				
Germany .....	....	....	5,831	....
Netherlands .....	....	....	....	595
Belgium .....	....	....	....	....
France .....	....	....	....	....
Czecho-Slovakia .....	....	....	....	....
Java	71,703	460	96,277	23,704
Philippine Islands .....	....	....	....	....
Onba	484	69,628	516,442	204,000
Dutch Guiana .....	....	259	58	1,261
Hayti and San Domingo ..	13	....	13	40
Mexico .....	....	....	....	....
Peru	2,437	4,725	32,386	62,801
Brazil	33	6,590	6,035	49,283
Mauritius	272	1,942	98,135	180,095
British India	1,167	....	15,613	1,466
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	2,532	6,629	121,538	88,529
Other Countries	2,330	87	28,026	38,394
Total Raw Sugars.....	80,972	90,310	920,353	661,168
REFINED SUGARS.				
Germany .....	....	....	126	1
Netherlands	2	4,062	1,063	73,911
Belgium	73	19	2,055	16,151
France .....	....	....	293	2,652
Czecho-Slovakia .....	....	....	102	138
Java .....	....	1,336	5,010	1,691
United States of America ..	1,599	32,070	102,215	161,838
Argentine Republic.....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	538	11,310	8,649	124,767
Total Refined Sugars ..	2,212	48,737	119,514	331,150
Molasses	2,006	8,213	57,833	66,903
Total Imports.....	85,190	147,260	1,097,700	1,099,321

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .....	....	....	....	1
Netherlands .....	....	78	2	1,714
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	159	71	634	1,085
Canada .....	....	....	....	....
Other Countries	1	274	52	2,165
FOREIGN & COLONIAL SUGARS.	160	423	688	4,966
Refined and Candy.....	653	39	2,800	330
Unrefined	986	146	7,917	2,366
Various Mixed in Bond....	....	....	....	....
Molasses	155	66	2,766	455
Total Exports.....	1,954	674	14,171	8,017

Weights calculated to the nearest ton.

Sugar Market Report.

Our last report was dated 9th September, 1921.

At time of writing, the market is suffering from depression, following the continued tale of sagging prices. Traders, with the experience of the past few months behind them, and the prospect of increasing supplies in the near future, are more than ever disinclined to anticipate requirements. The competition of American, etc., Granulated with British Refined, has made the running too rapid for prices to hold, so that in purchasing, the probability of a further decline seems to be always present. Old Crop Czecho-Slovak sugars are now finished, and offerings of New are coming in, to-day's asking price for SCH Fine, TTD/A, etc., Granulated for first week November delivery being 21s. 6d. f.o.b. Hamburg. Belgian Crystals can be bought for October at 19s. 6d., and Nov./Dec. has been sold to-day at 19s., a fall of about 3s. since our last report. American Granulated done at 49s. 6d. Spot, duty-paid terms, whilst October arrival is offered at 22s. c.i.f. The balance of the Government supply of White sugar on the spot, said to amount to upwards of 40,000 tons, is now definitely on offer at 48s. spot, and bids are invited. Tate's London Granulated is quoted at 51s., No. 1 Cubes 56s. 6d. Spot, duty paid, or 6s. and 5s. 6d. per cwt. respectively below the prices of a month ago. Cuban 96° Centrifugals are offered at 16s. 3d. to 16s. c.i.f. U.K.

In view of the interest shown in the progress of the European Beet crops, we append the latest figures of probable outturn, as given by Mr. F. O. LICHT:—

	Estimated Crop. 1921/22 Tons.	Actual Crop 1920/21 Tons.
Germany	1,300,000	1,106,000
Czecho-Slovakia .. .	650,000	715,000
France	300,000	388,000
Holland	330,000	317,000
Belgium	270,000	243,000
Total Europe	3,895,000	3,895,000

It would appear that on the whole, the crops generally have benefited by the weather of the past few weeks: Germany, France, and the Netherlands have enjoyed good rains, with heat favourable for the ripening of the roots, but Czecho-Slovakia complains of the effect of insufficient rains, with hot days and cold nights. From Holland an early starting of the crop is reported and it is said that she will have an exportable surplus of 150/170,000 tons.

The declaration by the Cuban Selling Committee about the 22nd September, of their intention to hold their price for raws rigidly at 3½ cents c. & f. New York, proved to be the prelude to the acceptance of bids at 2½ cents c. & f., upon which basis some 60,000 tons were disposed of. The official price remains at 2½ cents, but the pressing requirements of Refiners being momentarily satisfied by these purchases, a reduction to 2¼ cents would appear necessary if buyers' ideas are to be met. Latest cables from New York report business in Philippines at 4·12 cents spot duty paid; Granulated quoted 5·30 cents spot duty paid, and nominally 3·50 cents f.o.b. on the basis of full drawback allowance.

Cuban statistics for the period 1st December, 1920, to 1st October, 1921, compare with the two previous years as follows:—

	1921.	1920.	1919.
Total receipts	3,222,000	3,518,015	3,803,369 tons.
„ exports	2,035,000	3,492,900	3,225,883 „
Stock, 1st October ..	1,190,000	311,000	522,600 „
Centrals working ...	2	1	1

Mail advices from Mauritius, dated 10th September last, gave the total sales by the Syndicate to date as 8000 tons, and we hear of no important quantities having been sold since; the asking price of 21s. f.o.b. for Crystals is too dear against Bulgians and White Javas.

The shipments of White Javas to India during September are said to approximate 100,000 tons. At the moment the Indian markets are quiet, with few buyers, but a fair amount of business has been done during the month, more perhaps in the nature of book operations than on actual orders. Java values mark a decline to 13½ guilders for Whites, and 10½ guilders for Browns, f.o.b., but there are offerings here to-day of Whites at 20s. c. & f. Calcutta, Nov./Dec. shipment.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
October 11th, 1921.


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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Engineering Trade Conditions.

Both in the United States and in America, trade—in sugar machinery—has been very quiet the last few months. The Americans in particular have been adversely affected by the rate of exchange, which makes the original price in dollars of any goods a prohibitive figure when transposed into other currencies. Some American firms in the trade consequently find it well nigh impossible to secure business. In the United Kingdom the exchange handicap is far less excessive; but prices have been unduly high for many months, partly owing to the high cost of wages and raw material, and partly owing to output being on the low side—the worker has given too much thought to getting a good day's wages without troubling to consider whether he gave a good day's work in return. All these factors in both countries have tended to keep prices high. There is no lack of orders for new machinery or renewals in the memo books of hundreds of sugar factory owners all over the world; but the vast bulk of them are clearly being held up till the bottom of the market is supposed to be reached—in other words till prices come down to a figure which is more like the hypothetical post-war norm. How long individual orders will be withheld depends of course on the actual condition of the existing machinery, and after seven lean years during which the supply of repair parts and spare fittings has been seriously interfered with by the war and its aftermath, it is hardly to be expected that mills have been kept up to concert pitch in the majority of cases, so the present need for extensive repair or renewal is bound to be higher than would be normally the case. But where the need to repair or renew is not so urgent it is evidently good policy to defer the day of extensive reconstruction or enlargement till the cost of the new plant is a more reasonable figure.

On this assumption it is clear that the early revival of trade will depend on the expedition with which the cost of production can be reduced; once a more reasonable cost is indicated there should be plenty of orders. How far then have recent events in the industrial world tended to reduce costs?

The Labour Outlook at Home.

The coal strike of the summer was generally regarded as disastrous; but it is becoming clear that even that catastrophe had its redeeming features. It was a big struggle between a highly organized body of labour and the employers in a determined effort to maintain what the latter considered excessive and uneconomic wages—fixed in abnormal days. The miners would not concede the uneconomy and preferred to strike. The final settlement was not satisfactory to either party, and least of all to the large users of coal who are, in effect, the other labouring communities. But it at all events showed labour leaders the futility of trying to get an uneconomic standard of remuneration enforced by means of strikes. The lesson has not been lost in other quarters and the result is that other trade unions this autumn have preferred to compromise over the committee table and accept inevitable reductions in wages rather than face unemployment by resorting to force. The most important reduction recently has been in the wages of the engineering unions. The much criticized 12½ per cent. bonus addition to their wages which Mr. CHURCHILL was ill-advised to grant them at a critical stage in the war is at length to come off (in three stages between now and January). The final decision was left to the votes of the men without their leaders giving them any definite recommendation or warning them of the consequences of rejection. But individual commonsense triumphed and there was a majority for acceptance, so another disastrous suspension of industry has been averted.

This reduction in the wage bill for engineering work in the United Kingdom will go some way to cheapening costs of production which will be all to the good. But on every hand it is recognized that the real key to the situation is a supply of cheap coal which at present does not exist. The miners have talked of producing the coal *with Government assistance* at 30s. per ton for industrial purposes; but it is considered by some experts that to make the price of coal comparative with its pre-war figure (while allowing for differences of conditions) it will have to be procurable at 20s. per ton. Before the war it could be got for industrial purposes well below 10s. The price of coal thus governs the situation, and the sooner it can be reduced further, the more rapidly will engineering industry recover from the slump that has overcast it for the past year. We are hopeful that even here commonsense will ultimately achieve success, but it is not safe to count on any immediate fall to the desired minimum.

The trade outlook then appears to us more hopeful, though opinions differ as to whether any rapid recovery can be expected. But we do think that the worst has been seen in many respects. Labour is gradually realizing that it must do its share in maintaining trade and restoring prosperity, and now that it has reluctantly abandoned its claim to retain *sine die* the admittedly abnormal war-time rates of pay plus post-war rates of output, there is some good chance of industry becoming remunerative once more. Certainly the wage reductions must reflect themselves in all future quotations.

It might be permissible to remark here that, other things equal, firms who have kept their name before the purchasing public during the lean period should stand to gain most by any trade revival. It used to be said that the American producer was more enterprising than his British confrère in the matter of advertising. But as regards this particular industry, it has to be recorded that British firms have maintained a more even and steady standard of propaganda of late years. The American has tended to launch out advertising on a large scale while orders were coming in, but once times got lean the scale was reduced very materially—a policy which to many observers seems a reversal of the fitness of

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things. Then again, as we have seen pointed out, British firms have always appealed to a world-wide market and more easily reach it on occasion, whereas hitherto the American engineering firms have confined themselves chiefly to home and West Indian markets (of which Cuba was the Mecca). Now that there has been a cessation of orders from that quarter, American trade has suffered a serious set back which has not been lessened by the fact that in a number of instances previous orders from Cuba are still unpaid.

But all the various difficulties outlined above should in the end be overcome; the outstanding fact remains that the world as far as inclination goes can absorb a much larger amount of sugar than it can at present afford to purchase. But as international trade and industry revive, so will the purchasing power of the consumer, and we look to a steady if slow increase in the demand which will have its good effect on the machinery trade for many years to come.

Forthcoming British Trade Propaganda.

Two big organized attempts are being made by trading interests in this country to advertise British manufactures on a large scale in the near future, in both of which it is to be hoped British sugar machinery manufacturers will be induced to participate. One of them is to send a specially designed exhibition ship round the world calling at all the chief ports except those on the west coast of America. The itinerary will last 18 months and cover 43,000 miles, a stay of from a week to a fortnight being allowed at each place of call. This British trade ship which it is proposed to name "British Industry," will be a specially built liner of some 20,000 tons gross, and her internal arrangements will differ from those of any ship that has ever yet been floated. Every detail of her equipment from engines to fittings and furniture will itself be an exhibit of British workmanship at its best. But she will not be merely a sample of British shipwork; all available space will be devoted to the staging of exhibits, and of her eight decks four will be devoted to the exhibition proper. The rest of the space will be devoted to the usual cabin accommodation for the exhibitors, reception halls, a large restaurant, a cinema (which can be used for showing processes of manufacture) and other conveniences. It is proposed that this ship should set sail from the Thames in the summer of 1923. A floating exhibition like this should be a most valuable opportunity for manufacturers of British sugar-making machinery to exhibit (in model if not in full size owing to weight restrictions) their specialities; when it is considered that this vessel will call *inter alia* at Bahia, Rio de Janeiro, Buenos Aires, Durban, Brisbane, Fiji, Yokohama, Hong Kong, Manila, Singapore, Batavia and all the chief British India ports, it will be seen that the chance of showing sugar producers designs and samples of British made sugar plant and apparatus at points near their own localities is a unique one such as has never before been achieved. As compared with an exhibition on shore in the United Kingdom which would necessitate a long journey to visit, the taking of the exhibits almost to the doors of the potential purchaser is a distinct gain; and it is to be hoped that British sugar machinery manufacturers will be well represented on this ship even if it is necessary to limit both the space and the weight that they would normally wish to show. The S.S. "British Industry" is being organized by a company called The British Trade Ship, Ltd., and its offices are at 12, Grosvenor Gardens, London, S.W. 1.

Of lesser importance than the floating exhibition, but nevertheless of sufficient value to be likewise supported is the scheme for a British Empire Exhibition to be held in 1923 at Wembley Park (outside London). This is being organized with the approval of the Government, who are contributing £100,000 towards the

Guarantee Fund. Here space will be practically unlimited, as the ground extends to some 120 acres and considerations of weight will not apply. It is proposed to construct permanent exhibition buildings of steel and concrete, for while the exhibition mooted will only last six months, it is intended that the site shall become the home of the annual British Industries Fair and other periodic exhibitions, many of which are at present very cramped for room in their customary venues. To ensure the erection of the exhibition buildings and surroundings, a 'Guarantee Fund' of £1,000,000 is required (of which at least half has already been secured); it will, therefore, depend on the measure of financial support accorded the project by British industrialists as to whether the scheme is carried out. It is to be hoped that success will crown the venture. Promises to the Guarantee Fund should be sent to the Secretary, The British Empire Exhibition (1923) Inc., 16, Hobart Place, London, S.W. 1.

Production and Consumption: A German Expert's View.

In a recent issue of a German publication,¹ Dr. A. BARTENS, a well-known German authority on sugar matters, gives a useful résumé, illustrated by a table, of the sugar production from beet and cane in different countries from 1913-14 to 1920-21. The increase of 1,379,000 tons in 1920-21 over the previous year is to be credited entirely to improved conditions in the beet fields of Europe and the United States and not to any increase in area planted. The total production of sugar from the cane shows a slight decrease, owing to similar reasons in the Indian and Cuban fields: there was a fall of 200,000 tons in Cuba and 600,000 tons in India, while in most other centres there was an increase. We are still considerably behind pre-war production of sugar, even if we leave Russia out of consideration, whereas judging by the normal pre-war increase in consumption year by year (approximately half a million tons), we should now require some 22 million tons in place of the existing 16½. The world has not yet recovered in its sugar industry from the disturbance caused by the war, and the diminished purchasing power of the people has caused them to use less sugar. Dr. BARTENS believes that this stage is only temporary, and that in time the normal demand for sugar will reassert itself.

This estimate of Dr. BARTENS, we may observe, closely coincides with the figures we gave² in these Notes at the beginning of 1920; and we are glad that he has drawn further attention to what should be the normal world's consumption in happier circumstances, because it is to the interest of the sugar industry at large that it should not become more despondent over present prospects for production than the actual facts warrant.

The Cost of the Proposals of the Indian Sugar Committee.

In our last issue we referred to the very large outlay involved in carrying out the proposals of the Indian Sugar Committee for the improvement of the industry in that country. And we expressed some doubt as to whether, in view of the greatly altered general financial position since the report was written, the sums of money, capital and recurring, could be afforded. To anyone who has taken the trouble to refer back to the figures given in our September number, page 492, it will seem that a country with such great resources as India should not hesitate at the expense, in consideration of the great issues at stake. But the writer of the article in question has drawn our attention to the fact that the figures there given of the equivalents in English currency are unfortunately incorrect and should be

¹ *Sonderschrift der deut. Zuckerind.*, 1921, 44.

² See *I S.J.*, 1920, 2.

Notes and Comments.

approximately ten times as much. The statement of the cost of the proposed Research Institute should read as follows:—"Rs. lakhs 35½ (at 1s. 4d. the rupee £236,666 and at 2s. £355,000) as a capital charge, with a recurring expenditure of Rs. lakhs 12 per annum (at 1s. 4d. the rupee £80,000 and 2s. £120,000), assuming that the sub-stations are self-supporting." Similarly, lower down on the page, "The initial cost of the factory is put down at Rs. lakhs 59 (at 1s. 4d. the rupee £393,333 and at 2s. £590,000)." We regret that these errors have been allowed to pass into print unobserved, and call attention to them because such sums call for very careful consideration in even the wealthiest country.

The Work of the Insular Experiment Station in Porto Rico.

On another page we give various extracts from the general portion of a report on the work of the Insular Experiment Station in Porto Rico, from which it is obvious that a great deal of hard work is being put in by the officers of the station, in spite of the frequent and regrettable changes which occur. But when the scientific work of the different sections, which are not dealt with, is run through, a doubt arises in our mind as to whether the amount of work attempted is not too great for the staff, the bulk of it falling, of course, upon the shoulders of the heads of divisions. The programme of work proposed for the year 1920-21 confirms us in this opinion, and we are not surprised that certain projects are, from time to time, deliberately dropped from sheer inability to bring them to a successful conclusion. We note a great improvement in the general character of the work during the past two years, but still think that too little attention is being paid to purely cultivation problems, in view of their importance in the control of pests and diseases and the necessity for increased production in case of a fall in the price of sugar. A better result would also be obtained if a less imposing list of subjects were included in each year's programme, and some check placed on publication until definite results are arrived at. On comparing the sections, perhaps the greatest progress has been made in the division of plant pathology and, closely connected therewith, the office of the expert in cane diseases, but excellent work continues to be done in entomology. The chemical section, on the other hand, appears to concern itself little with the sugar industry; and, with the exception of some important work in connexion with yellow stripe disease, appears to confine itself mainly to analyses called for by the other branches. It may be that the staff is inadequate, but in such a country as Porto Rico there should be a vast field of research in the sugar industry from the chemical point of view.

The Kelham Beet Factory.

The Kelham beet factory, a venture that has been heralded for two years past, was opened on November 2nd, by the Minister of Agriculture, Sir ARTHUR GRIFFITH BOSCAWEN, M.P., in the presence of a distinguished gathering of those long interested in the inauguration of a beet sugar industry in this country.

The factory site extends to 41½ acres. It has a capacity of 60,000 tons of beet per campaign or 600 tons per day of 24 hours. The expected production is 8000 tons of sugar, 3000 tons of dried beet pulp, 1800 tons of molasses, and a large quantity of lime waste. Some 6000 tons of coal and 3000 tons of limestone will be required during the campaign. Ample supplies of water for washing the roots are available from the Trent adjacent, and 300,000 gallons of water per day are being drawn from the town supply for the 14 diffusers. The factory was designed and the machinery manufactured by the French firm of Fives-Lille, but

the eight water-driven centrifugals were supplied by Messrs. WATSON, LAIDLAW & Co., Ltd., and there are four Stirling boilers.

At the luncheon following the opening, it was admitted that it was not expected at first to make the venture pay; in fact, Sir ERNEST JARDINE told the company that this year they were paying £19,000 more for the roots (at £4 per ton) than they would get for the sugar without making any allowance for manufacturing costs. Next year all they would be able to guarantee the growers was 30s. per ton—a figure which did not strike the farmers present as particularly attractive in view of the present cost of labour. It is clear that the cost of agricultural labour is going to be the deciding factor in making or marring the success of this factory. If the economic price the latter is prepared to pay for the roots is not enough to allow the farmer to pay his way at existing wage rates, and wages cannot be lowered sufficiently to meet the farmer's balance sheet, the farmers will lose their enthusiasm for the project and the factory may be unable to secure a sufficient supply of roots. The whole scheme bristles with difficulties; but it is to be hoped these will be surmounted in time.

The Barbados Sugar Crop of 1920.

The Barbados sugar crop of 1920, according to a Colonial Office report, was adversely affected by a shortage of rainfall in 1919, and in consequence amounted to 21,416 tons less than the crop of 1919, or a total of 48,212 tons, the smallest yield for the past five years. The largest crop of recent years was that of 1916, when 73,581 tons of sugar was exported.

Prices obtained for the product during 1920 varied to an unprecedented extent. In January sugar was selling at \$10 per 100 lbs. and fancy molasses at 80 cents per gallon. In May the prices had risen to respectively \$20 and \$1.20. In August the market broke and on March 31st, 1921, the price of sugar was \$5 to \$5.50 while fancy molasses fetched 35 cents. In those circumstances the year 1920 proved a very speculative one in Barbados and large sums of money were made and lost. As an instance, the local Government fearing a shortage of sugar for local consumption retained in January, 1920, approximately 5,000 tons for Barbados. The price paid was \$10 per 100 lb., which enabled it to be retailed at 12 cents (6d. per lb.). This proved a great benefit to the people, who would otherwise have had to pay as much as a shilling a pound for sugar while the high prices ruled, but when the market broke the Government naturally had to reduce the retail price in order to get rid of the sugar, and by selling below cost price lost £58,000 odd on the transaction. The inflated price of sugar also gave rise to a certain amount of speculation in land, and estates changed hands at prices which make it appear that their purchasers must have calculated upon selling their sugar at about \$10 for the next five years or so. Twenty-four estates, comprising 6766 acres in all, were sold in 1920 for £990,650, or an average of £146 per acre.

The Director of Agriculture reports that the seedling canes B H 10 (12), Ba 6032 and Ba 11,569 still continue to give excellent results when compared with White Transparent and B 6450. The first named has shown a percentage increase over White Transparent of 61.3. But a number of sugar cane experiments have been rendered valueless owing to the attacks of root borer (*Diaprepes abbreviatus*) and the brown hard-back (*Phytalus smithi*).

Fifty Years Ago.

From the "Sugar Cane," November, 1871.

In this number ROUSSEAU published a further article¹ on his so-called "sacrate of lime" process, in which he proposed that the beet farmer should extract the juice from his roots by rasping and pressing, treat it with an excess of lime sufficient to form calcium trisaccharate, and place this product on the market in a dry state for purchase by the sugar factories, according to its saccharine content.

FELTZ contributed a paper calling attention to the supposed loss of sucrose occurring during the diffusion process, to which matter allusion was made last month.² Experiments were described for the purpose of showing that a considerable fermentation was capable of occurring unless an antiseptic had previously been added, and that this was induced by the ferments introduced with the weak juices. It was therefore proposed that these weak juices should preliminarily be treated by the carbonation process before bringing them in contact with the fresh slices.

At a public meeting held at St. Johns, Antigua, on August 31st, 1871, it was resolved by a large majority of the resident proprietors that steps should be taken for the establishment of centrals, seeing that the large factories erected in Martinique and Guadeloupe had abundantly proved the value of the system.

An interesting paper by E. J. MAUMENÉ, translated from the *Journal des Fabricants de Sucre*, described the preparation and properties of compounds between sugars and salts, to which work reference was recently made by Dr. HELDERMAN, in connexion with his discussion on the validity of Geerligs' theory of the formation of molasses. MAUMENÉ stated that if a cold aqueous solution of 85 parts of sugar and 15 parts of sodium chloride were allowed to evaporate down slowly (under a bell-jar containing a vessel filled with sulphuric acid), one could obtain large ortho-rhombic crystals having a sp. gr. of 1.574, combined with one molecule of water, these crystals decomposing at 239° F. (115° C.), to $(C_{12}H_{22}O_{11})_2NaCl$ with the evolution of water, "caramelin" being formed at higher temperatures.

An account was given by Dr. HASSAL of the *Acarus sacchari*, together with an illustration of this insect drawn by SMITH, BECK & BECK, microscopists, London. *Inter alia* it was stated that the *Acarus* is to be found only sparingly, if at all, in low sticky sugars, since these "clog its pores and air-vessels, and are moreover unsuited to its active disposition." Nitrogenous matters were thought to be necessary for its growth and propagation.

A Spanish chemist, A. DELORME, proposed a method of determining sucrose and reducing sugars, depending upon two observations: (1) the polarimetric rotation; and (2) the copper reduction. Having ascertained the quantity of reducing sugars present by the copper test, the rotation due to this amount (assuming it to be invert sugar) was calculated, and the observed total rotation of the sample increased accordingly, the figure thus obtained being considered to be equivalent to the sucrose content.

¹ *I.S.J.*, 1920, 190; 1921, 248.

² *I.S.J.*, 1921, 550.

Recent Work in Cane Agriculture.

CANE GRUB INVESTIGATIONS IN QUEENSLAND. *Dr. Illingworth. Circular Report, 27th May, 1921.*

This opens with an account of the season's growth in the Cairns district in north Queensland. D 1135 appears to be excellently suited to the poorer soils of this part, but it is less satisfactory in the richer scrub land, where its growth is rank and the stalks, being thin and long, lodge and root at every part touching the ground. Harvesting such fields is a very troublesome piece of work.

The effect on white grub of flooding the land is discussed in some detail. After the heavy rains in the early part of the year a number of apparently dead grubs were seen on the surface, but these when collected soon showed signs of reviving. This led to a series of experiments, in which single grubs were placed in pots full of soil and immersed in water for varying short periods, to determine how long the grubs could resist the action of the flooding. It was found that in one or two days the weaklings were destroyed, in three to four days all the grubs showed signs of distress, while in five the whole of them were killed. This however is a long period as regards the cane plant itself, and the effect of the heavy rains was seen in the decay of the end buds and the protrusion of laterals, thus throwing back the crop, with an estimated loss in some cases of 50 per cent. at harvest. A further effect of the floods upon the grubs showed itself in a pronounced outbreak of the muscardine fungus among them.

In experiments with arsenic, sowing this poison in the bottoms of the furrows before planting unfortunately turned out a complete failure. This may possibly be due to the grubs being forced upwards by the heavy rains, thus rising above the action of the poison which, being heavy, tends rather to sink in the soil. It will be remembered that this method was accompanied by marked success in a period of drought (*I.S.J.*, 1921, page 257).

Drilling the arsenic at the sides of the cane rows, on the other hand, met with marked success, if the quantity used was large. The method was not completely satisfactory unless 200 lbs. were given to the acre. In the untreated plots the roots were entirely eaten off and even the cane stems were badly gnawed, whereas in the plots treated with large doses the roots were untouched and quite healthy, firmly fixed in the soil and extending to 12 ins. in length. In some of the untreated plots the grubs were attacked by fungus, in one case 90 per cent. being thus destroyed.

A STUDY OF NATURAL METHODS OF CONTROL FOR WHITE GRUB. *Bureau of Sugar Experiment Stations, Queensland. Division of Entomology, Bulletin 12, 1921.*

This bulletin consists mainly of a study of the muscardine fungus of white grub in the cane fields, and these chiefly on the Greenhills estate where the matter has been most thoroughly investigated. The area of the normal grub infestation is shown on a map of the estate, and the spreading of flights of the beetles in the heavy storm winds of the early part of the year is clearly indicated. It is interesting to note that the author concludes that the range of flight is normally small and dependent on the prevailing wind, no more than half a mile, an observation in agreement with similar infestations on the Nilgiri hills in south India. The usefulness of poultry in keeping down the beetles is also demonstrated by the effect of removing the birds from a part of the estate which they appear to have kept quite clear of the pest. A certain amount of success has been obtained

Recent Work In Cane Agriculture.

by artificial infection with fungus material raised in the laboratory, but it is emphasized that it is idle to use this method in parts where the grubs are not already present in quantities.

REPORT OF THE COMMISSION ON ROOT BORER AND BROWN HARD-BACK OF THE SUGAR CANE IN BARBADOS. 1919.

There appears to have been some delay in printing this report which has only just been received.¹ The terms of reference include only the root borer (*Diaprepes abbreviatus*) but the Committee wisely extended their enquiries to the brown hard-back (*Phytalus smithi*) and many of the witnesses failed to distinguish between the two. A map (not printed) was appended from which it appears that practically one half of the island is affected and that the attacks are severe in seven parishes. The report is concise and to the point, and is limited to 3½ closely printed folio pages. This tends to clarity and the more voluminous appendices contain details for those interested in special points. Appendix I contains the evidence of the witnesses: II and III give interesting scientific accounts of the two pests, presumably prepared by BAILLOU, and IV a pamphlet of BOVELL's reprinted, with general recommendations as to treatment: these two gentlemen were members of the Committee. We thus have clear statements of the life history and habits of these troublesome pests in Barbados, together with the findings of a strong Committee as to the way in which they should be fought, and the action being taken by the local planting community. Unfortunately the latter do not appear to be altogether inclined to take the necessary steps to rid the industry of this danger (one quarter of the witnesses summoned took no notice of the request to give evidence), and the Committee points out very clearly the effect of half-hearted measures on the multiplication of the insects and on the industry generally.

The root borer is the grub of a striped beetle known for many years in Barbados as the "lady-bird," but which has only become a serious pest during the past ten years. It tunnels into the underground stem and causes losses varying from one-sixth to one-half of the crop where at all abundant. The hard-back, known only for the past 10 or 12 years, in the grub stage feeds upon the fibrous roots of the cane, but no data are available as to the amount of damage caused by it. The recommendations of the Committee contain little as to remedial measures that has not already been published by the local and Imperial agricultural departments. As to parasitic insects, it is stated that none are known in the case of the root borer. The brown hard-back is parasitized by *Tiphia parallela*, but the control of the pest by it appears to be unsatisfactory; so also is that by its natural enemies, birds, lizards, and toads. In view of the apathy of many planters no legislative measures are suggested as serving any useful purpose, but there was a strong agreement among the witnesses as to the value of various agricultural measures which had been recommended. Such are rotation of crops, collection of eggs and adults of the root borer, and full-grown beetles of the hard-back, regular and persistent efforts to destroy the beetles before egg-laying, destruction of grubs by digging out stumps attacked by the root borer and in bad cases subsoiling, and for the hard-back the introduction of *Tiphia* where it is not already present, planting trap crops, and the use of poultry and especially pigs in the fields.

As corollaries to these recommendations, it is pointed out that suitable food plants are needed for *Tiphia*. In Barbados it feeds upon the honeydew exuded by

¹ I.S.J., 1921, page 337.

Sorghum crops, in St. Kitts it is found plentifully on the flower buds of the sword bean (*Canavalia ensiformis*), whereas in Mauritius it feeds on the hairs of *Cordia interrupta*. The latter plant has already been introduced into the colony, and the growth of *Canavalia* is open to any planter. These recommendations have already been placed before the planters. Incidentally, it is stated that the root disease is a very serious one in the cane fields, and that any control of the root borer will inevitably lead to the diminution of this disease as well.

The possibility of increasing the rotation of crops in Barbados receives some attention, and the Committee has some suggestions to make. It appears that it is not possible to increase the growing of sweet potatoes, and even if it were this would not meet the difficulty to any extent. The Committee suggests, as an alternative crop, that of cotton, and calls on the Government to open farms throughout the island for the purpose of supplying good seed. It also suggests that attention should be paid to building up an animal industry, the growing of food for which should help in the matter. For this purpose improved breeds of working and dairy cattle should be introduced, and especially new good kinds of pigs, the value of which in keeping the hard-back in check has already been referred to. The Committee, in further support, quotes a bulletin issued by the Illinois Experiment Station, in which it is stated that the introduction of a drove of pigs into land heavily infested by hard-back rid it of this pest to the extent of 99 per cent. As a further source of food for cattle and pigs, ensilage should be taken up on scientific lines, and the Committee asks the Government to install an up-to-date silo in which various fodder and other crops may be thoroughly tested. The report appears to be a real attempt to improve the local practice, and it will be interesting to see what action is taken by the Barbados planters in the matter.

ANNUAL REPORT OF THE INSULAR EXPERIMENT STATION, DEPARTMENT OF AGRICULTURE AND LABOUR, PORTO RICO. 1919-1920.

The Director, E. D. COLÓN, occupies exactly two-thirds of this hundred-page report, and then follow a series of quite short statements of the work done by the expert in cane diseases, agronomist, chemist, entomologist, pathologist, and veterinary inspector. The matter is, as usual, interesting, and the form and size of the publication convenient. There is a good deal of repetition in the work of the various heads of sections, as the director surveys every part of the work under his control, and, as a certain amount of the scientific research on sugar cane in Porto Rico has already been referred to in this journal, we propose in the present notice only to deal with certain points in the director's portion of the report, and especially those that refer to the sugar industry as a whole.

The first subject which attracts attention is the personnel of the experiment station. In reviewing the 1917-18 report we drew attention to the frequent changes in officers who were in charge of the different lines of research, and mentioned that "it would have made the study (of the work done) easier if some details had been given of these changes, as it is sometimes desirable to have a knowledge of the status of the authors of the multitude of papers referred to." We therefore welcome the table on page 6 giving the movements of the personnel during the fiscal years 1918-20. There appear to be 21 appointments on the list, and of these only eight were in charge of the same officer during the two-year period: the average duration of service during the 24 months was 10 months for each officer. The amount of time lost during the same period, owing to posts being temporarily unfilled, was 14 months. These figures show that this evil has

¹ I.S.J., 1921, p. 73.

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by no means ceased to exist, and the director recognises the dislocation of work caused thereby, and writes "it would be no *expense* but a *saving* for 'the People' of Porto Rico" to remunerate its necessary positions in such a fashion as to induce parties to accept them and retain them at least long enough for their efforts to bear fruit." He further points out that, if rises in pay are not possible, it would be economical to reduce the personnel while not relinquishing any of the appropriation for salaries, so as to make the major appointments more attractive.

Sugar cane work predominates at the Insular Experiment Station, the area devoted to it equalling that under pasture and meadows and being six times that under all other crops. One half of the sum devoted to farm expenses is spent in labour connected with this crop alone. The same dominance is observable in the official programme of work for the year, some of the subjects dealt with being:—Cane seed distribution, study of sugar cane varieties, experiments in manuring sugar cane, possible changes in yellow striped cane, chemical composition of filter-press cake and fermentation changes on adding other materials, chemical analysis of cane varieties, white grub work, possibility of insect transmission of yellow-stripe, yellow-stripe investigations, and the *Rhizoctonia* of Porto Rico.

Seed distribution seems to have been very large, 129 tons to 101 applicants, but the results have proved very unsatisfactory. The seed arrived in very poor condition, because of uncontrollable delays and rough handling, and the planters took no special care of it. In fact, in the majority of cases, they appear merely to have obtained the seed cane to fill their area, instead of sacrificing millable canes of their own. This was especially the case in fall planting, and they did not mind what the seed cane was, so long as the station supplied them with it. It is obvious that this was not the aim of the agricultural department, and the supply of seed with such great precautions and at such great cost was wholly unjustifiable. The director suggests that in future seed from the station should only be supplied in small quantities to be multiplied by the growers.

An interesting review of the Porto Rico sugar industry is contained in the director's report. The area under cane is estimated at 240,000 acres; in 1919-20 the production was 485,887 tons of sugar, valued at \$108 millions (leaving out syrups and molasses). A table gives details for each year from 1914 to 1920; the export rose from 320 to 420 thousands of short tons and the total value from \$20 to \$100 millions in the same period, the price per ton of sugar rising from \$63 to \$235. In this prosperity both the centrals and the colonos shared. The more common basis for payment by the centrals for cane delivered by the colonos has been a certain per cent., in tons of sugar, of the tonnage delivered at the scales. In certain factories payments for cane are arranged on the basis of sugar in the cane delivered. But in both cases disputes have arisen between the factors and growers, because of the variety of cane grown, the effect of burning poor crops before reaping, and delays in shipping and grinding. Three cane varieties appear to be specially objected to by factors, Yellow Caledonia, D 625, and Cavangerie, all of them giving high tonnage with low sucrose and purity. The experiment station has been asked by both parties to investigate these matters, and a number of observations and experiments have been made to fit this authority to act as umpire.

Labour also has shared in the prosperity of the industry. In 1918-19 the wages paid per diem in different parts of the island varied from \$1 to as much as \$1.50 during the cutting season, and 65c. to 90c. at other times. Stimulated by the good prices in view for sugar, the labourers began a series of strikes at a critical

¹ 'The People of Porto Rico' is the official title of the owners of the Experiment Station.

period of the 1919-20 harvest, and in late January these had become pretty general. The demands were approximately for \$2.50 for an eight-hour day for men and \$1.25 for boys harvesting cane, \$2 for men and \$1 for boys cultivating cane, and \$2.75 to \$3 for ditching. As a general result of this action, wages during the cutting season have been raised nearly 50 per cent., and 20-30 per cent. afterwards. The bulk of this burden naturally falls upon the grower of the cane, and, although he would be able to bear it with the high prices for sugar ruling at the time, on a return to more normal prices he would have to reduce his labour bill or stop work. The average cost of raising cane per acre in several of the larger centrals is given as \$208 to \$247 for plant cane and \$180 for ratoons. As a reduction in wages is not an easy matter to negotiate, increased production becomes imperative, and the station authorities have tackled the problem and issued a Circular (No. 17) in which the problem is stated and the whole question discussed at length.

There has been much activity in the publication of results in all sections of the Porto Rico Agricultural Department. Besides various reports, the station officers have written 28 articles in the *Revista* and 19 papers on work done in the station. In the past, the bulk of this work has been written in English and was thus not available for the bulk of the people of the island. A change had been commenced during the previous year, and during the year under report it has been decided that all circulars will be written in Spanish, and English translations only made as far as funds permit.

VARIOS TRABAJOS. *Departamento de Agricultura y Trabajo Estacion Experimental Insular, P.R. Circular No. 33, 1920.*

This presumably is one of the circulars referred to in the last note, and is accordingly written in Spanish. It contains a series of papers presented at a meeting of cane growers and factors at Rio Piedras on the 17th November, 1920. The papers deal with the Yellow Caledonia cane in Porto Rico, the varieties of cane grown in Porto Rico, experiments in manuring cane, recent developments in cane disease, tractors, control of mosaic disease, cattle diseases, and other subjects.

ANNUAL REPORT OF THE BUREAU OF AGRICULTURE IN THE PHILIPPINE ISLANDS FOR 1920. *Published by the Government of the Philippine Islands, 1921.*

As is usually the case, this report is concise and well illustrated. It covers 65 printed pages interspersed with 52 beautiful plates and certain graphs in the text. The six leading crops in the Philippines are rice, corn, *abaca* (Manila hemp), sugar cane, coco-nuts and tobacco. These crops are somewhat cursorily dealt with in six pages at the beginning, dealing with crop conditions, and about 11 pages at the end concerning experimental work, with four pages on pests and diseases.

In common with other countries, the islands found the year one of unexampled prosperity. The director of agriculture, ADRIANO HERNANDEZ, opens as follows: "It is gratifying to state that never before in the history of Philippine agriculture has there been greater prosperity among the farmers, nor has there been a year in which greater progress has been made in agriculture than that of the year 1920. The increase in the area planted to crops, the corresponding increase in yield, and the stupendous increase in value received, makes a new record of advancement for this important industry The introduction of modern tractors and gang ploughs has become quite general in the sugar-producing provinces, and will no doubt be extended to the rice fields more generally just as soon as irrigation projects are completed, thus making their use practicable"

Recent Work in Cane Agriculture.

The area under the six chief crops has increased 45 per cent. from 1910 to 1920, while the average yields per hectare have risen 21 per cent. in the same period. These six crops are dealt with in short sections of about half a page, but each is accompanied by a graph illustrating the rise in production during the 11-year period, and an excellent map of the islands giving the proportional area cultivated in the several districts and provinces. As regards sugar, there was a decrease in the area planted, because of violent tornadoes, of 1 per cent. as compared with the previous year, yet total sugar production showed an advance of 3 per cent. Needless to say, the value of the crop exceeded that in the previous year by 114 per cent. During the 11-year period the production of sugar has risen from 150 million kgs. to nearly 450 millions. The map graphically indicates the relative importance of the sugar cane crop in all parts of the group. There is a great concentration in Occidental Negros, with 75 to 150 million kgs.; in Pampanga and Batangas, 25 to 75 million kgs. are produced, while, in Oriental Negros, Iloilo, Laguna, Tarlac and Ilocos Sur, from 10 to 25 millions are produced; but sugar cane is grown in almost every district throughout the Philippines, a fact indicating the enormous potentiality in the production of sugar under-favourable conditions.

The experimental work is in its infancy and consists of the usual acclimatization and testing of varieties (local, introduced, and Philippine seedlings), the control of pests and diseases, manurial tests, spacing and breeding work.

A REVIEW OF THE SUGAR TRADE IN INDIA DURING THE CALENDAR YEAR 1920.

Wynne Sayer, *Secretary Sugar Bureau, Pusa. Supplement to the "Indian Trade Journal," August 25th, 1921.*

This important paper covers a far greater field than its title indicates, and should be consulted by all who wish to follow the course of sugar production, export, import, and prices in India, in the two years before the war, and the last three. The mass of statistics dealt with has been drawn from the official publications of the Indian Statistical Department and is presented in a very concise and readable form. WYNNE SAYER concludes as follows:—"As India's production of refined sugar is at present only 177,569 tons, it is obvious that there is ample scope for many times the number of factories now working in India. The prospect before the Indian sugar industry is very hopeful as it can choose the most favourable parts of the country for supply for many years to come, and with the increased duty on foreign sugar coupled with heavier freight and handling charges it would be well if capitalists devoted their time and attention more and more to developing the industry on a sound and scientific basis. There is ample scope and the rise in the cost of production throughout the world both of raw material and of the finished product has told heavily in India's favour, as all commodities which have to seek a distant market are taken toll of by conditions which a producer in a home market never experiences. The value of this fact has not yet been sufficiently grasped in India."

REPORT ON THE PREVALENCE OF SOME PESTS AND DISEASES IN THE WEST INDIES DURING 1919. *West Indian Bulletin, XIX.*

Sugar cane pests are detailed on pp. 20-22 as follows:—Moth borer (*Diatraea saccharalis*), weevil borer (*Spenophorus sericeus*), root borers (*Diaprepes abbreviatus*, etc.), cane fly (*Delphax saccharivora*), white ants and termites, hard-back grubs. Among the parasitic insects on pests, *Tiphia parallela* is referred to from Antigua on page 31. The cane diseases are dealt with on page 35 and include root disease (*Murasmus sacchari* and allied species), rind fungus (*Melanconium sacchari*), red rot disease (*Colletotrichum falcatum*) and pineapple disease (*Thielaviopsis ethacetica*).

The Possibilities of the Java Seedling Canes in Louisiana.¹

By W. E. CROSS, Ph.D.

At the annual meeting of the Louisiana Sugar Planters' Association, which took place in New Orleans on the 10th March of this year, I recommended that the Java seedling canes now universally planted in Tucumán be introduced into Louisiana and studied under the conditions of that State.

It is always difficult to predict the results that will be obtained with any particular variety in any country, and indeed many predictions made in different parts of the world have by no means been justified by the results obtained. Take one or two instances in Tucumán itself. At one time a large amount of Barbados 208 was imported by one of the factories, whose technical advisers thought that great results were to be expected from this cane. The cane was an absolute failure under the conditions of this province. At another time the D 74, which had given such splendid results in Louisiana, was planted in Tucumán on a considerable scale,—but this cane also resulted in a complete failure.

While fully realizing, therefore, that prophecies of this nature are somewhat daring, we permitted ourselves to recommend the Java seedling canes POJ 36 and POJ 213 for Louisiana, our recommendation being based upon our experience in Louisiana during the years 1910-14, and our experience with the Java seedlings in Tucumán during the past seven years.

In comparison with Tucumán, Louisiana is much more favoured by natural conditions for the cultivation of the cane, and yet in spite of this the results they obtain there are not so good as those obtained in Tucumán.

Tucumán receives some 35 inches of rain per year; Louisiana has some 66 inches. In comparison with Tucumán, the climate in the hot months in Louisiana is much more uniformly tropical, with much more of that moist heat so desirable for the development of the cane. The Louisiana soils, in the sugar belt, are almost all alluvial, and exceptionally fertile. Louisiana does not have such extremely severe frosts in winter as does Tucumán. In spite of these advantages, Louisiana cannot produce cane of more than one year ratoons; there they have to practise a rigorous system of rotation, ploughing under leguminous crops one year in every three; they have to apply considerable quantities of commercial fertilizers to their cane, and, on account of the frosts, their harvest has to be practically concluded by the end of December. Tucumán on the other hand obtains ratoon crops from its cane up to six or eight years, gives little or no attention to the question of rotation of crops, uses no commercial fertilizers, and defers its harvest until June to October,—and yet obtains with the Java seedling canes better yields of cane and sugar per acre than those generally obtained in Louisiana.

It is generally believed in Louisiana that the necessity they have of following a rigorous system of rotation of crops, of applying generous quantities of commercial fertilizers to the cane, and of harvesting so early as they do, is due to their natural conditions of soil, climate, etc. In considering this idea, let us think for a moment of what we should have had to do in Tucumán after the degeneration of the Cheribon cane in the years 1915-16, if we had not already discovered the fact that the Java seedlings were so eminently suited to our conditions, that is to say, if we had had to go on with the Cheribon cane. We should probably have had to limit ourselves to two or three years' ratoons, we should have had to

¹ *Revista Industrial y Agrícola de Tucumán*, Vol. XI, p. 118, (1921).

The Possibilities of the Java Seedling Canes in Louisiana.

stimulate the cane by the application of nitrogenous fertilizers, and the frequent ploughing under of leguminous crops. Because of the low resistance of the Cheribon cane to the effect of frosts, which in these last years have been unprecedentedly severe in this province, we should have had to harvest the cane much earlier than is our custom, with the consequent serious deterioration of the stubbles cut at the beginning of the winter, which would have absolutely necessitated the replanting of the cane every two or three years.

That is to say, that in all probability, if Tucumán had not abandoned the Cheribon cane and substituted for it the Java seedling varieties, we should have had to adopt a system of agriculture identical with that at present practised in Louisiana.

This leads us to the view that the necessity encountered in Louisiana of cultivating the cane in such an expensive way, with relatively mediocre results, may perhaps be due, not so much to the climatic and other natural conditions, as is generally supposed, as to the varieties of cane cultivated.—which are the same as those abandoned in Tucumán, the Cheribon and the D 74. That is to say, the cultivation of those canes, which are so susceptible to certain cane diseases, like root disease and the mosaic, as also to frost damage, is what causes it to be necessary in Louisiana, as it would be in Tucumán, to employ expensive methods with poor results.

I ventured, therefore, to recommend to the Louisiana planters that they introduce and study these Java seedlings, which have enabled Tucumán to avoid the adoption of those expensive modifications of its system of agriculture which without doubt would have been necessary if we had continued with the Cheribon cane. Studying in detail the qualities which these canes have shown in Tucumán, their possibilities in Louisiana would appear still more promising. And in the first place we must remind our readers that these seedling varieties were produced in Java by crossing the Cheribon cane with the variety Chunnee. This latter is an extremely hardy variety, woody, vigorous, and extremely resistant to disease, which grows almost without cultivation in northern India, in a zone of heavy frosts and conditions generally adverse. These hybrids, the POJ 36 and POJ 213, combine the qualities of the two parents, being rich in sugar like the Cheribon, and very vigorous and highly resistant to diseases and frost damage like the Chunnee. They have not had great success in tropical countries, because there, with conditions very favourable to the growth of the cane, less hardy and richer varieties may be employed with success. But for subtropical conditions they are among the best varieties which we know up to the present.

I believe that Louisiana is the only important subtropical country which to-day is trying to carry on a cane industry on the basis of tropical varieties. In Tucumán the POJ 36 and 213, in Egypt the POJ 105, all hybrids of the Chunnee cane, in Natal and Madeira the Uba or Kavaugire, an Indian cane of the same type as the Chunnee, have replaced entirely or in greater part the tropical canes formerly planted.

We may summarize the qualities of the Java seedlings POJ 36 and 213 as follows:—

(1) Vigorous varieties of great ratooning power, which give heavy yields of cane per acre. The factor which most limits the yields obtained in Tucumán is the low annual rainfall. In Louisiana, with its abundant rainfall, this limiting factor disappears.

(2) Varieties of low cost of cultivation, as they grow very rapidly in the spring, permitting a very early "lay-by." Their development in the spring in

Tucumán is somewhat retarded by the fact that the spring rains begin very late ; in Louisiana, where the spring rains are earlier and more abundant, their early development would probably be much more marked than in this province.

(3) Very resistant to the cane borer (*Diatraea saccharalis*), a very serious cane pest of the Cheribon cane, both in Louisiana and in Tucumán. After the adoption of the Java varieties in this province, the borer has ceased to be a pest of importance.

(4) Much more resistant to frost damage than the Cheribon cane and the D 74. I believe that with the Java seedling canes in Louisiana it would be possible to defer the harvest from the present period, November-December, to December-January or even January-February, without danger of suffering undue losses due to frosts. This would imply a double advantage. The factories would grind much riper cane than under the present system, and the disastrous effects produced on the stubbles by early cutting there as in all subtropical countries would be avoided.

(5) More resistant to the root disease and the mosaic disease. The Louisiana authorities are trying to eliminate the mosaic disease by destroying the attacked plants, but the great extension which this disease has already acquired makes very doubtful the ultimate success of this effort. The mosaic disease is found in all parts of Tucumán, but the Java seedling canes appear to suffer hardly at all from its effects.

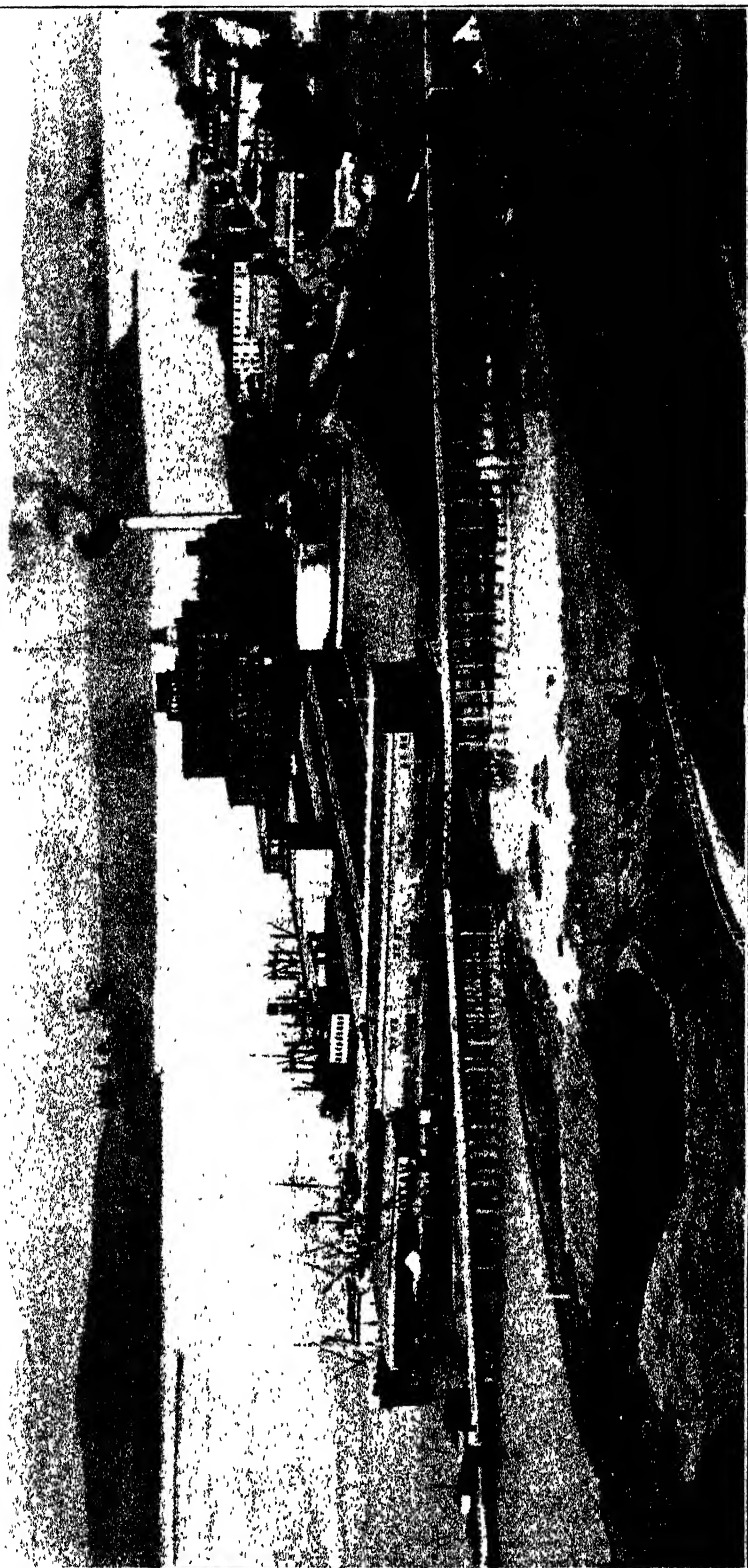
(6) Greater resistance to the rotting of the stubbles during the winter. This deterioration of the stubbles, especially when the cane is cut early in the winter season, is one of the prime causes of the reduced yields obtained from the Cheribon cane in Tucumán when it reaches the second or third year's ratoons. The rotting suffered by the stubbles in Louisiana is probably greater than here, because there the winters are very moist, thus furnishing the favourable conditions necessary for the active development of the destructive organisms concerned. For this reason first year's stubble in Louisiana gives less cane than the plant cane, and not more as in Tucumán ; while the second year's stubble gives so small a yield as not to be worth cultivating.

(7) Finally the Java seedling canes in question are much more fibrous than the Cheribon, containing an average of 12.5 per cent. fibre, as against 10.0 or 10.5 for this latter cane. With a high fibre cane it is possible to obtain a higher sucrose extraction with the same mill, while the greater quantity of bagasse obtained per ton of cane enables the factory to eliminate the expensive additional fuel.

The Federal laws of the United States prohibit the importation of cane from mosaic-infected regions. On the other hand the mosaic disease is widely diffused in Louisiana, and especially in the grounds of the Experiment Station, where the studies with these canes would at first be carried out. And seeing that these varieties do not suffer materially from the effects of the mosaic, it would appear unfortunate that the government authorities continue to insist in refusing to admit them into the country for experimental purposes.

In an article which appeared in our October issue¹ on the Jamaica sugar industry from the pen of a correspondent of ours, it was incorrectly stated that the machinery for the Gray's Inn central had been supplied by a Glasgow firm. We learn that, as a matter of fact, the whole of the machinery for this factory was supplied by Messrs. GEORGE FLETCHER & Co., Ltd., Derby, and it is in course of erection under the supervision of that firm's own staff of engineers.

¹ I. S. J., 1921, 561.



THE NEW CROCKETT REFINERY, CALIFORNIA.

The Crockett Sugar Refinery.

In May last an address on sugar refining was delivered before the San Francisco chapter of the American Society of Mechanical Engineers, by Mr. GEORGE M. ROLFE, who gave an account of the recently reorganized Crockett (Cal.) plant, of which he is Superintendent. This sugar-house has a capacity of 2500 tons in 24 hours, and is controlled by the Californian and Hawaiian Sugar Refining Corporation. Although Mr. Rolfe's paper dealt with the subject of sugar refining in a general way for the benefit of those having no intimate acquaintance with the industry, it contains some details which certainly should be of interest to our readers. These are here briefly summarized.

As will be seen from the photograph, the site combines both rail and deep water facilities for receiving and shipping sugar. The refinery, which draws its supplies from the Hawaiian Islands, begins operations in January and completes the year's work about the beginning of December. The fact that the plantations produce raw sugar over a period of eight months, while the refinery operates during 11 months, makes it necessary to provide large warehousing facilities, viz., three months' supplies of raws, and at least 30 days' production of refined, or a total of about 150,000 tons.

Many schemes have been devised for unloading the raw sugar from the ships to the docks by conveyors, but as yet nothing has successfully replaced the sling and derrick. The new dock is a double one, and discharging takes place on both platforms simultaneously, the cost of unloading to the steamship company being only about 30 cents per ton. From the dock the raw sugar is transferred by conveyors, either to the store, or else directly to the fourth floor of the melt-house of the refinery.

Affining centrifugals.—In the reorganization of the Crockett plant, three improvements have been made. The first concerns the installation of Watson-Laidlaw motor-driven centrifugals, which are self-discharging, whereas the old closed-bottom belt-driven type required about 20 per cent. of the total time of the cycle for emptying. Although this saving of time does not appear large, it means that the new machines are capable of handling 25 per cent. more charges per 23-hour day. They have a diameter of 48 in., and the height of the vertical section is 24 in. The bottom of the centrifugal is open, the opening being 33½ in. in diam., the lower 15½ in. of the basket tapering at an angle of 60°. The calculated capacity is 11.9 cub. ft., with a magma wall thickness of 11 in. Approximately 5 secs. after the machine is started, the basket reaches a speed of 250 revs. per min., which is considered the right time to charge, this operation taking 20 secs., at the end of which time the speed has reached 650 revs. per min. During the next 45 secs. the basket has reached the full speed of 870 revs. per min., and the syrup is spun off. Water is applied during 75 to 90 secs. to wash off the impurities, using about 34 lbs. per charge (1220 lbs.) at 40 lbs. pressure; and after it has been shut off the spinning continues for 30 secs. to dry the crystals, the brake being then applied. It requires 2 mins. to bring the machine to a stop, but a moment or two before this occurs the washed crystals (which contain 2 per cent. of water) drop into the bins below, the entire lot discharging in 2 secs. Each of these self-discharging centrifugals has a daily capacity of 100 tons of raw sugar, compared with 50 tons in the case of the old belt-driven machine, so that the present installation of 22 machines is equal to 44 of the others. A man operates as many of the new as of the old, so that the cost of labour is cut in half, in addition to which there is a great conservation in floor space.

Sweetland filters.—Bag filters have now been abandoned in the Crockett refinery; and the second notable improvement that has been made is the installation of Sweetland filters in their place. This has eliminated a large part of the labour, and has done away with an exceedingly disagreeable and troublesome operation.

A Sweetland press has an effective filtering area of 1044 sq. ft. (72 leaves, each having an area of 14.5 sq. ft.); and will handle raw liquor equivalent to 100 tons of raw sugar per 24 hours period in 16-18 cycles. It holds approximately 630 gallons, 20-40 gallons being returned for refiltering at the beginning of each cycle before it is cleared. After filling first with what is known as "smear liquor" (liquor containing a higher proportion of "Filter-cel" or kieselguhr than the ordinary product), then with the liquor to be filtered, the apparatus is put under a pressure of 10 lbs. per sq. in., which is increased gradually until 50 lbs. is reached, at which point the filter produces approximately 15 galls. per sq. in. of filter surface per hour. Then the rate of filtration is gradually reduced, until at the end of 60 mins. it is approximately $\frac{1}{2}$ gall. per sq. ft. of filter surface per hour, making an average of approximately $2\frac{3}{4}$ galls. per sq. ft. for the period of cycle. After the pores of the filter have become clogged, and the pressure is taken off, the liquor remaining in the filter is discharged, and sent back to the blow-ups. The leaves of the filter are cleaned of the impurities and the cake of "Filter-cel" by means of a spraying device. It requires 48,000 galls. of water per 100 tons of raw sugar to sluice the Sweetland press, or about 1900 galls. per filter, the average time being about 10 mins. The filter cloth used is a light cotton twill having a life from 60 to 75 days.

Calandria pans.—The third radical change at the Crockett plant is the development of calandria pans. These have a heating surface approximately 56 per cent. greater than the coil pan, and are used with exhaust at about 15 lbs. This change was brought about by the modification of the power plant, in which steam is generated at 150 lbs. pressure, run through turbines and discharged with a back pressure of 10-15 lbs., electric power thus being obtained as a by-product at a comparatively slight cost per kilowatt hour. Last year the fuel used per ton of sugar melted was 13 per cent. less than the average for the previous five years, notwithstanding the power was a by-product. When all the steam is used the power generated costs about $\frac{1}{10}$ cent. per kw. hrs., but as at present all the exhaust is not used, it works out at $\frac{1}{4}$ cent. per hour. Two 14 ft. calandria pans are being installed at present, and it is hoped that these will permit of a solution of the steam balance, making use of all the exhaust. When operating at 2000-ton capacity, 1,000,000 galls. of water is evaporated in the boiler plant, approximately one-half of which is return drips. The average CO_2 in the flue gases is $13\frac{1}{2}$ per cent., and the boiler efficiency is 79 per cent.

Lastly, it may be mentioned that the Crockett refinery has developed opportunities for the welfare of its workers in providing play-grounds and parks, clubs for men and women, a library, gymnasium, swimming pool, and the like. It has never had a strike, and was the first sugar refinery in the United States to operate an eight-hour day.

With reference to the paragraph in our October issue under *Brevities*,¹ mentioning the appointment of Mr. E. WUTHRICH as general representative for South Africa of the Sugar Machinery Manufacturing Co., Ltd., London, this firm now announces that Mr. WUTHRICH will no longer act for them as from December 20th next.

¹ I.S.J., 1921, 585.

Notes on the Cuban Sugar Industry.

Writing at the end of September our Havana Correspondent stated that notwithstanding the difficulties with which estate owners in Cuba have had to contend, the present Cuban output of sugar is a big one; the total output indicated at that date was from 3,410,000 to 3,460,000 long tons. This is certainly a remarkably good performance when one considers the conditions that existed during the crop, the principal of which was the lack of funds.

This output comes from 196 centrals, the capacity of which is shown in the following table :—

17 centrals making up to 5,000 tons.			
45	"	"	from 5,000 to 10,000 tons.
33	"	"	" 10,000 " 15,000 "
36	"	"	" 15,000 " 20,000 "
25	"	"	" 20,000 " 25,000 "
9	"	"	" 25,000 " 30,000 "
5	"	"	" 30,000 " 35,000 "
8	"	"	" 35,000 " 40,000 "
3	"	"	" 40,000 " 45,000 "
4	"	"	" 45,000 " 50,000 "
2	"	"	" 50,000 " 55,000 "
2	"	"	" 55,000 " 60,000 "
3	"	"	" 60,000 " 65,000 "
2	"	"	" 70,000 " 75,000 "
1	"	"	" 80,000 " 90,000 "
1	"	"	110,000 "

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The lowest output for any one central was 488, while the highest is achieved by an Oriente central with 111,330 tons.

The situation in the sugar industry of Cuba remains one of great hesitancy. While a very large part of last crop (some one and a half million tons) is still unsold, the banks are not inclined to advance money to factory owners on next season's production. And they have a good reason for taking that stand, for if a large part of this year's crop is carried over to next, it will certainly have a tendency to bring down the price of sugar. Again, as the Sugar Commission is not selling much of Cuba's sugar, it certainly appears that a large surplus will be carried over to next crop. Therefore, bankers very properly argue that to advance money on what might probably be a falling market, means insecurity, and they are consequently holding back.

With very little sugar being sold, the immense stocks in the warehouses are decreasing but slowly. It appears that the only solution to this stagnant condition is increased consumption. To increase consumption the price of sugar must be brought to the point that encourages the masses to consume it in large quantities—the price must be lowered. And this is precisely what the Commission do not want to do. Does the Commission expect a better price later, and a market for all the sugar? Or is consumption so low that heavy purchases cannot be financed?

Some more factories have begun repair work preparatory to the coming crop. But only those owned by strong Companies or Corporations are doing substantial repairing; the others have not the financial backing to do justice to the overhaul and maintenance of their factories, and some of these are so weak financially that

they may not be able to get through the next crop for lack of efficient repairs or of funds. Being in so bad a way, the banks will not assist them in face of the uncertainty of the sugar market, so their contribution to the new crop is doubtful.

Most of the Companies or Corporations referred to are in some way, directly or indirectly, connected with refineries, and this fact gives them an advantage, in years of abnormal conditions, over those factories that are not in any respect so connected. In other words, the individual owner is in a bad way this year, and cannot get the financial aid he requires to carry him through his repairing season, as he would have if he had been part of a Corporation with a string of connexions, such as a refinery, a bank, or an interlocking directorate. These are conditions that exist and are felt this year, and will be so felt as long as the present situation lasts. Fortunately the weather has been favourable for the growing canes, and, where some attention was given the fields, good crops are coming on. Everything points to quite enough cane being grown to make a big crop, except in some districts, and it will not be surprising to see Cuba, in spite of her troubles, obtain another large output in the 1921-1922 season.

Trinidad.

Cane Farming and Sugar Crop Returns, 1912-1921.

(Compiled by Edgar Tripp & Co.)

Year.	Total Sugar made, tons.	Tons of Sugar made from Estate Cane.	Tons of Estate Cane Ground.	Tons of Cane Purchased.	Amount paid for Canes. £	NO. OF FARMERS.	
						East Indian.	West Indian.
1921 ..	54,933*..	24,207 ..	286,974 ..	389,399 ..	1,773,227 ..	15,046 ..	11,379
1920 ..	58,416 ..	28,953 ..	319,421 ..	344,226 ..	2,924,404 ..	14,536 ..	10,824
1919 ..	47,850 ..	24,656 ..	275,451 ..	270,324 ..	1,210,155 ..	12,370 ..	8,568
1918 ..	45,256 ..	22,644 ..	252,783 ..	266,144 ..	812,247 ..	12,158 ..	8,244
1917 ..	70,891 ..	36,102 ..	378,999 ..	384,650 ..	1,093,770 ..	12,055 ..	8,984
1916 ..	64,231 ..	35,653 ..	426,106 ..	363,775 ..	1,008,665 ..	14,014 ..	8,212
1915 ..	58,882 ..	34,376 ..	426,262 ..	325,071 ..	869,790 ..	9,202 ..	7,078
1914 ..	55,488 ..	35,690 ..	407,797 ..	201,799 ..	486,630 ..	7,450 ..	5,253
1913 ..	42,331 ..	31,095 ..	346,912 ..	136,724 ..	330,364 ..	6,942 ..	5,513
1912 ..	40,936 ..	27,856 ..	315,762 ..	151,697 ..	358,428 ..	6,983 ..	6,042

In 1920 Java sugar was imported into Formosa for refining purposes to the extent of 32 million kin (18,928 long tons) valued at 10 million yen (£1,025,000 at par); in 1920-21 the amount dropped to 19 million kin (11,238 long tons) valued at less than 3½ million yen (£358,750).

Writing on the question of the waste of fuel in industrial plants,¹ Mr. DAVID BROWNLEE, B.Sc., F.C.S., states that a complete investigation has been made of 400 boiler installations in 41 factories in Great Britain, representing 1513 boilers, with a total coal bill of 3½ million tons per annum. The average net working efficiency was only 58 per cent., whereas 75 per cent. should be reached with scientific methods of control, though 82½ per cent might be attained under what are termed "ideal conditions." Out of the 400 plants, 149 obtained an efficiency of only 55 per cent., "a shocking figure," corresponding to an immense waste of valuable fuel.

* Of which Usine St. Madeleine produced 17,740 tons, Waterloo 6554 tons, and Caroni 5175 tons.

¹ *Daily Mail*, September 9th, 1921.

Calculation of the Proportion of Sugar due to the Planter in Payment for Cane.

In the Philippine Islands this question was recently debated by prominent technologists, the increase during the past few years in the number of centrals milling cane for planters "on shares" having demanded the consideration of a practical and equitable method.

Mr. L. W. THURLOW¹ in opening the discussion pointed out that at best the calculation as made at present can only be a close approximation, since it is based on two inexact assumptions: (1) the sucrose and juice extraction of each planter's cane is the same; and (2) the ratio of sucrose in cane to sucrose in crusher juice (that is, the Java ratio) is constant. A third assumption is made, namely, that the ratio of the purity of the crusher juice to the purity of the mixed juice is constant; but this is very nearly true.

In order to make an approximately correct division, it is necessary to calculate the following values from the laboratory records: Per cent. of available 96.5 test sugar $T = S \times R \times Q \times \text{pol. crusher juice}$, in which S is the factor of the available 96.5 test sugar, based on the actual apparent purity of the molasses discharged for the period under consideration; R is the sucrose extraction in the cane for each planter; and Q is the ratio $\frac{\text{sucrose per cent. cane}}{\text{sucrose per cent. crusher juice}}$ for each planter's cane.

Then the tons of available 96.5 test sugar = tons of cane $\times T$; and from this value and the weight of cane delivered by each planter the division is made.

Mr. THURLOW drew attention to the fact that for the calculation of the available 96.5 test sugar, some chemists adopt Winter's formula with an arbitrary purity of 28.5 for the final molasses. This is wrong, because the formula should be based on the actual purity of the molasses discarded, whether it be 36° or more or less. Much more logical is the method of calculation evolved by DEERR and MORSE (who both arrived at the same formula); and the apparent purity values may be safely applied for the determination of the yield, the boiling-house efficiency, and the division of sugar.

Mr. E. T. WESTLY² replied to Mr. THURLOW by saying that the ratio of sucrose in the cane to the sucrose in the crusher juice should run very constant, and should not show any very wide variations (such as 72 to 77, cited by Mr. THURLOW). Regarding the matter of true and apparent purity values, it makes very little difference in the case of mixed juice and sugars which be used; but in the case of waste molasses the difference between the two is great and the apparent value cannot be applied. Thus let us employ Deerr's formula for a juice having a Brix of 15, a polarization of 12.00, a sucrose content of 12.10, an apparent purity of 80.0, a gravity purity of 80.66; a sugar having an apparent purity of 97.5 and a gravity purity of 97.8; and a molasses with a Brix of 90.00, a polarization of 27.0, a sucrose content of 36.00, an apparent purity of 30.0, and a gravity purity of 40. Using the apparent purity value throughout as recommended by Mr. THURLOW,

we would have: $\frac{97.5 (80.0 - 30.0)}{80.0 (97.5 - 30.0)} = 90.28$ per cent. recovery. Using apparent purities for the mixed juice and sugar, but gravity values for the molasses: $\frac{97.5 (80.0 - 40.0)}{80.0 (97.5 - 40.0)} = 84.78$ per cent. And using gravity purities for sugar, juice

and molasses, we get: $\frac{97.8 (80.7 - 40.0)}{80.7 (97.8 - 40.0)} = 85.33$ per cent. Whereas the recoveries

¹ *Sugar News*, 1921, 2, No. 2, 90-93, and 114.

² *Ibid.*, 1921, 2, No. 5, 168-170.

stated by the last two are fairly close to one another, the first is far too high. With products of the above analysis, it would be impossible to recover 90·28 per cent.

Very satisfactory results have been obtained in the calculation of the sugar resulting from each planter's cane by the application of the following data: the ratio between the polarization of the cane, and the polarization of the crusher juice for the particular day; the polarization of the planter's cane; the extraction; the difference between the purity of the crusher juice and that of the syrup; and the boiling-house recovery by Deerr's formula, using the gravity purity of the molasses. This boiling-house recovery is then applied to the planter's extraction per cent. cane, and the per cent. over-all recovery calculated, this figure being finally applied to the planter's tonnage to obtain the proportion of sugar due to him.

If, for example, a certain planter delivers 100 tons of cane, and the following data are found: Brix, polarization, and apparent purity of the crusher juice, 20·0, 16·00, and 80·00; ratio between sucrose in the cane and sucrose in the crusher juice, 81·00; extraction, 96·0; polarization and apparent purity of the sugar made, 96·0 and 97·0; gravity purity of the waste molasses, 37·00; and difference between the purity of the syrup and that of the crusher juice, 1·0. Then $16·0 \times 81 = 12·96$ polarization of the cane; and $12·96 \times 96 = 12·44$ polarization extracted per cent. cane. Recovery by Deerr's formula, 85·95; and $12·44 \times 85·95 = 10·69$ over-all recovery. This is equal to 10·69 tons of polarization, and corresponds to 11·135 tons of 96 test sugar.

Mr. MANUEL L. ROXAS¹ said that the Java ratio, that is the ratio between the polarization of the cane and the polarization of the crusher juice, may be used in a more direct way. The constant for sugar distribution is obtained from the expression:
$$\frac{\text{pol. mixed juice per cent. cane} \times 100}{\text{pol. per cent. cane}} \times \frac{\text{pol. per cent. cane}}{\text{pol. crusher juice}}$$

on simplifying becomes:
$$\frac{\text{pol. mixed juice per cent. cane} \times 100}{\text{pol. crusher juice}}$$

zation mixed juice per cent. cane is obtained by dividing the tons polarization in mixed juice by the weight of cane, so that the simplified constant assumes the form:
$$\frac{\text{tons pol. mixed juice} \times 100}{\text{tons cane} \times \text{pol. crusher juice}}$$
. If this constant is multiplied by the

polarization of the crusher juice of a given planter's cane ground on a particular day, and the product multiplied by the weight of his cane, the amount of polarization passing into the mixed juice from his cane will be obtained. This multiplied by the boiling-house recovery in terms of 96·5 test sugar for that day, and again multiplied by the partition factor, be it 50 or 55 per cent., gives the sugar corresponding to the planter's cane.

This method of calculation assumes that the fibre per cent. and extraction are the same for all canes. In one of the mills of the Philippine Islands, the maceration is varied with the fibre in the cane, and the extraction thus made constant. Another assumption made is that the polarization in the mixed juice bears a fixed ratio to the polarization per cent. cane, and the polarization of the crusher juice, which is only approximately true.

However, the constant for a given day will express very fairly the average ratio of the amount of sucrose delivered by the mill in the mixed juice from every ton of cane for every per cent. of polarization in the crusher juice, and will indicate very approximately the factor for the distribution of sugar. It will vary from day to day, and therefore the use of a constant from the weekly average figures

¹ *Ibid.*, 1921, 2, No. 4, 130-134.

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will result in an unfair distribution of the sugar. All methods of distribution are only approximate, and any difference between the calculated and the actual amount of sugar produced should be balanced out to the planters at the end of each run or the end of each season, in proportion to the total amount of sugar delivered by each, as shown from the analysis of their canes.

Mr. R. C. PITCAIRN¹ next contributed a note describing the method of distribution of sugar to *hacenderos* as practised by the Hawaiian Philippine Co. Two daily constants are determined. The first is known as constant *C* and is simply the extraction multiplied by the Java ratio (polarization per cent. cane divided by the polarization of the crusher juice, the result being multiplied by the mill extraction of sucrose per cent. sucrose in the cane). The second is known as constant *D*, and is found by dividing the average purity of the mixed juice for the day by the average purity of the crusher juice. The polarization of the crusher juice for each *hacendero* multiplied by constant *C* gives the polarization of the mixed juice per cent. cane; and the purity of the crusher juice multiplied by constant *D* gives the purity of the mixed juice. Using this purity of mixed juice, the boiling-house recovery for each planter's juice is determined by means of the *S. J. M.* formula. Then the polarization of the mixed juice per cent. cane \times boiling-house recovery gives the available sugar in the cane; and the tons of cane \times available sugar in the cane gives the tons of available sugar in the cane, or the "calculated sugar." The amount of calculated sugar for each *hacendero* is totalled; and the sugar actually produced divided by the calculated sugar gives a factor which multiplied by the amount of calculated sugar for each *hacendero* gives the sugar produced from his cane. This quantity of sugar is then divided between the central and the *hacendero* in the proportion stipulated in the milling contract.

Lastly, Mr. THURLOW,² having considered the comments made by his colleagues, offered the following procedure as a standard method. The data used are: (1) The ratio of the purity of the mixed juice to the purity of the crusher juice (from the analysis of each planter's cane); (2) Java ratio \times mill extraction \times factor of factory efficiency for the season; (3) (*J-M*) factor of recovery for the 96.5 test sugar corresponding to the apparent purity of the mixed juice.

Then polarization of crusher juice \times (2) \times (3) = actual per cent. of 96.5 sugar recovered, on the cane milled, without the need of making any weekly corrections. The computation can be easily carried out daily with the aid of a calculating machine. From time to time the factor of factory efficiency might have to be changed to conform with the actual operation of the plant. An average could be easily distributed.

Mr J. SYDNEY DASH has resigned the directorship of the Station Agronomique, Guadeloupe, and has been appointed tobacco pathologist at the Central Experimental Farm, Ottawa, Canada.

The acreage planted with sugar in Mexico during 1920-21 was smaller than in former years, though the price was sustained throughout the year. The yield not being sufficient to cover local wants, large quantities were imported from Java and Cuba.

In our abstract of Mauritius Bulletin No. 21, dealing with the question of the composition and utilization of exhausted molasses,³ we inadvertently omitted to state that Mr. C. D. D'AVOINE was joint-author with Dr. TEMPANY of this particularly valuable and thorough research.

¹ *Ibid.*, 1921, 2, No. 5, 171-172.

² *Ibid.*, 1921, 2, No. 9, 361-363.

³ *I.S.J.*, 1921, 410.

New York Meeting of the Sugar Section of the American Chemical Society.

On September the 7th to 9th, the annual meeting of the Sugar Section of the American Chemical Society was held at Columbia University, New York. Dr. C. A. BROWNE was in the chair, and Dr. F. J. BATES acted as Secretary. There was a large attendance, including a number of British and Canadian visitors; and the meeting was opened with the announcement by the Chairman that the Council of the American Chemical Society had decided to elevate the Sugar Section to the status of a self-governing division.

For the coming year the following officers were elected: Chairman, S. J. OSBORN; Vice-Chairman, F. W. ZERBAN; Secretary-Treasurer, F. J. BATES; and Executive Committee, C. A. BROWNE, C. E. COATES, W. D. HORNE, W. B. NEWKIRK, H. S. PAINE, and H. E. ZITKOWSKI. Dr. BROWNE, the retiring Chairman, was tendered a rising vote of thanks for his untiring efforts in guiding the Section from its beginning to its organization as a Division.

A number of interesting papers were read, short abstracts of most of which are here given.¹

Origin and Development of the Cane Sugar Industry in America. C. A. Browne. A notable feature of the meeting was a lecture by Dr. BROWNE, illustrated by lantern slides and by the exhibition of old prints, tracing the history of cane sugar manufacture from the earliest time to the present day. Pictures of two of the first saccharimeters used in the United States were also shown.

Dietetic Value of Sugar. W. D. Horne.—This was a paper showing that sugar is "a great source of cheap energy which the world has been slow to appreciate in its full significance . . . Its supply can be greatly increased as demanded, and its price should grow relatively lower with the expansion and development of the industry . . ." Dr. HORNE presented data discussing the rôle of sugar in a rational well-balanced ration. Authoritative experiments show that 5 ozs. of sugar can be easily digested daily by an adult, indicating the probable safety of increasing the sugar in our bill-of-fare by 20-30 per cent. A table showing the *per capita* consumption in lbs. for 1910-11 and 1921 (estimated) was published, the values for the principal countries for these two periods being as follows:—New Zealand, 130, 100; Australia, 129·6, 100; United Kingdom, 91·7, 66; United States, 79·2, 90; Germany, 47·9, 50; France, 42·8, 34; Europe (average), 35·7, 24; Cuba, —, 112.

Mechanical Clarification of Cane Liquors. A. S. Elsenbast.—In Louisiana last season the juice from about 70,000 tons of cane was filtered through presses after the addition of kieselguhr ("Filter-cel"), and a good plantation white sugar and high-grade syrup was thus made without any treatment with lime or sulphur.² For whole juice filtration, 6 sq. ft. of filtering surface per ton of cane ground in 24 hours, and 10-30 lbs. of kieselguhr per ton of cane are required, but tropical juices require only about 5 lbs. For syrup filtration the figures are 3·5 sq. ft. and 0·5-1·5 lbs. In the manufacture of plantation white sugar by the sulphitation process the figures for syrup are 2·5 sq. ft. and 0·5-2·0 lbs. In raw sugar manufacture, the use of lime in the treatment of defecation mud is eliminated with advantage by the addition of 1-4 per cent. of kieselguhr to the muds previous to filter-pressing. In the refinery in the production of "standard granulated," washed

¹ For these we are indebted to the courtesy of the American Chemical Society News Service.

² *I.S.J.*, 1920, 332, 643, 699.

New York Meeting of the Sugar Section.

sugar liquor is filtered through 10 sq. ft., using 5-6 lbs. of kieselguhr per ton of solids, while for the washings or washed syrup 30 sq. ft. are necessary with 20-30 lbs.

Deterioration of Cane Products. C. A. Browne, C. A. Gamble, G. H. Harding, and M. H. Wiley.—Soft refined sugars were found to differ in keeping quality from raw sugars, torulas being the principal micro-organism concerned, whereas raw sugars contain moulds and bacteria also. In such deterioration, the invert sugar was found to decrease, and the sucrose to change but little. Some final Cuban molasses showed a decrease of 5.94 per cent. polarization, and 5.06 per cent. sucrose in seven years. Attention is called to the importance of the deterioration occurring in the cane between cutting and grinding, especially in circumstances where an interval of several days or even a week is not an uncommon occurrence.

Adsorption Isotherms of Decolorizing Carbons. F. W. Zerban and S. Byall.—Isotherms have been determined for the decolorization of molasses solutions of varying concentration by six different carbons. It was found that, while for one carbon and one concentration the logarithmic curves closely approximate to straight lines, there is a marked difference in the constants of the adsorption formula for one carbon at varying initial concentrations of molasses solution, and for the same initial concentration, using different carbons.

Preparation of high-power Carbons. Chr. E. G. Porst and John M. Krno.—By the use of steam activation and leaching and other means, decolorizing carbons were produced from lignite, sawdust, spent boneblack and other materials; and these were found to be equal and in some cases superior, as regards decolorizing value to those now on the American market.

Preparation of Bagasse Carbon. C. E. Coates.—Bagasse was subjected to destructive distillation at a temperature of 550-600°C. (so as to avoid choking the pores with hydrocarbons¹), ground up, heated to 850-900°C. "for some time," cooled, boiled with 20 per cent. sodium hydroxide solution for 15-20 minutes, rinsed, washed with hydrochloric acid and water, and finally re-heated to 200°C. It is stated that this char was found to be 2½ times stronger than the best decolorizing carbon on the market. It exhibited a marked adsorbing power towards iron in solution.

Fundamentals of Sugar Colorimetry. H. H. Peters and F. P. Phelps.—Solutions must first be freed from insoluble suspended solids; and the best way of attaining this is to pass about 80 c.c. of the solution at about 80° Brix, five or six times through a crucible containing an asbestos plug of about 1½ grms. Beer's Law was found to be valid for concentrated impure sugar liquors of about 50° Brix, but dilution with water changes the degree of dispersion and the colorimetric value of the colloidal non-sugar, invalidating Beer's Law. New spectro-photometric standards, far more rigorous than the present technical colorimetric methods, were established by the authors, and the effect of some 20 carbons thus examined.

Testing Quartz Control Plates. F. P. Phelps.—All quartz plates sent to the Bureau of Standards are subjected to tests examining: (1) the quality of the mounting; (2) homogeneity of the quartz; (3) planeness of the faces; (4) parallelism of the faces; (5) the "axis error"; and (6) the precise rotation from which the sugar scale value is calculated. A tentative set of specifications has been drawn up. Some plates tested at the Bureau have been found to have an actual value differing from that stated by the maker by approximately 0.2°S.

¹ Cf. CHANEY, I.S.J., 1920, 229.

The Estimation of Raffinose and Sucrose in Beet Products. R. F. Jackson.—

A modification of the enzyme method permits an accurate determination of true raffinose without incurring the difficulty of measuring small changes in polarization in the presence of large amounts of invert sugar. After sterilization of the molasses, the greater part of the invert sugar is removed by fermentation with bakers' yeast. The solution containing the melibiose is filtered, evaporated, and divided into two aliquot parts, which are diluted one-tenth, one with water, the other with invertase-melibiose solution extracted from brewers' yeast. After hydrolysis, both are analysed for reducing sugars, the difference between them being a measure of raffinose. The method is standardized against pure raffinose. By the above method analyses were made of samples of Colorado beet molasses, which were found to contain non-sugars polarizing from -0.04 to 1.08 S., which polarizations are due to levo-rotatory gums and amino-compounds. True raffinose was found to be sometimes less and sometimes greater than that indicated by Clerget. From the true raffinose and true sucrose, the direct polarization of the sugars was computed. The difference between the calculated and observed direct polarizations gave the rotation of the non-sugars. In every case these proved to be negatively rotating.

Cobb's Gunning Disease. C. F. Walton, Jr., and O. S. Keener.—Gum passing into the juice from cane infected with *Bacterium vascularium* does not appear to be removed by the ordinary liming method of clarification, as layers form on the coils and collect in the centrifugals. Laboratory experiments, however, indicated that liming to distinct alkalinity to phenolphthalein precipitates all the gum, which thus behaves quite differently from the so-called "beet gum." Cane gum reduces Fehling's solution, but gave no test for pentose. It was completely precipitated by basic lead acetate under ordinary analytical conditions.

Precipitation of Gum from Beet Molasses. H. S. Paine and C. F. Walton, Jr.—About 1 kg. of the molasses was diluted with 10 litres of water, 1.4 litres of ammoniacal lead acetate and 0.4 litre of strong ammonium hydroxide added, and the precipitate filtered off, suspended in water, and decomposed with 1:4 sulphuric acid. The filtrate was neutralized with solid barium hydroxide in the cold, concentrated *in vacuo*, and dialysed in running tap water. The dialysate was clarified with neutral lead acetate, the excess of lead removed with sulphuretted hydrogen, and the dialysis completed in distilled water. A gum was thus obtained having a specific rotation on the basis of the total solids in the purified solution of -38.8° .

Manufacture of C. P. Dextrose. C. E. G. Porst and N. V. S. Munford.—It is stated that the method used for the preparation of chemically pure dextrose¹ demanded the use of alcohol for washing and a crystallization from the same medium. This method was abandoned on account of its excessive cost; and that now used employs "cerelose" as a raw material and decolorizing carbon or bone-black for removing the colour.

New Processes in the Sorghum Industry. J. J. Willaman.—An abstract of this paper has already been published.²

Among the other papers read were the following: "Purification of Enzyme Solutions," by F. W. REYNOLDS; "Comparison of Various Corn Starches," by CHR. E. G. PORST and M. MOSKOWITZ; "Preparation of Levulose from Invert Sugar," by C. S. HARDING; "Use of the Plastimeter for determining the Viscosity of Starch Pastes," by CHR. E. G. PORST and M. MOSKOWITZ; "A Simple Diffusion Battery for Laboratory Experiments," by M. J. PROFFITT.

¹ See also *I.S.J.*, 1921, 575.

² *I.S.J.*, 1921, 585.

New Clarifying Agent for the Clerget (Double Polarization) Method, effecting a High Degree of Decolorization.¹

By H. KALSHOVEN and C. SIJLMANS.

The clarifying agents which have been in use in Java for a long time past in the determination of the true sucrose content of molasses, namely, basic lead acetate and aluminium hydroxide (Tervoooren's method), have the great disadvantage of generally effecting an insufficient decolorization, so that the liquid, especially before inversion, cannot be read with the necessary accuracy.

By making use of basic lead nitrate and aluminium sulphate, we have discovered a method of clarification by which a high degree of decolorization can be effected, while, further, its application is very simple.

BASIC LEAD NITRATE.

The clarification of impure sugar solutions (especially molasses) by means of basic lead nitrate, which is formed in the solution itself by the successive addition of normal lead nitrate and sodium hydroxide, dates from 1890, when it was recommended by HERLES in Bohemia.² It has now been in general application in that country for a number of years. Basic lead acetate forms a precipitate with certain substances in the molasses, and adsorbs the colouring matters from solution. On the other hand, basic lead nitrate is but little soluble; and by being formed in the solution itself it effects a much more intense adsorption, a greater amount of precipitate being formed, and less lead remaining in solution.

HERLES represented the reaction thus: $2\text{Pb}(\text{NO}_3)_2 + 2\text{NaOH} = [\text{Pb}(\text{NO}_3)_2 + \text{Pb}(\text{OH})_2] + 2\text{NaNO}_3$; and he operated with solutions of known strength and precisely measured quantities, in order that no excess of alkali should be added, a condition that would result in the formation of $\text{Pb}(\text{OH})_2$, so that lead saccharate might be thrown down.

On filtering off the precipitate, however, from the liquid obtained by the addition of equivalent amounts of the reagents (according to the above equation), a somewhat acid liquid is obtained. In fact $1\frac{1}{2}$ times the quantity of alkali stated may be used before an alkaline filtration is obtained, and the explanation of this is that in addition to $\text{Pb}(\text{NO}_3)_2 \cdot \text{PbO}$, other basic lead nitrates, as $\text{Pb}(\text{NO}_3)_2 \cdot 2\text{PbO}$ and $\text{Pb}(\text{NO}_3)_2 \cdot 5\text{PbO}$, are also formed.

Therefore the effect of using more alkali than HERLES was examined; and on doing this it was found that the decolorization was considerably greater. Moreover, the peculiarity was noticed that with the addition of more alkali, the polarization before inversion was higher, and that after inversion was lower, the sucrose content, however, remaining unaltered.³ Hence, the more basic is the precipitate, the more reducing sugars are removed from solution (and whether this be due to the formation of an insoluble compound with the dextrose or levulose, or whether the reducing sugars are merely carried down with the precipitate, is here of little importance).

¹ Abridged translation of an article published in the *Archiel*.

² *Zeitsch. Zuckerind. Bohm.*, 1888-89, 557; 1889-90, 343; and 1896-97, 189.

³ Figures are reproduced in the original article demonstrating this point.

One may thus recommend that the quantity of alkali to be added should be regulated according to the capability of reading the solution, and should be independent of the higher or lower values of the polarizations. In the directions given at the end of this paper the quantity is stated which with Java molasses give solutions capable before inversion of being polarized in the 400 mm. tube.

In regard now to the application of this method of clarification, we have applied it to the determination of the sucrose content of a great number of molasses in comparison with basic lead acetate. Higher results were always obtained in the use of the nitrate as compared with basic acetate, namely 0 to 0.5 per cent. higher, averaging 0.28 per cent. for 18 samples.

Now it does not seem to us to be a great objection to find by this new procedure a sucrose content a few tenths of a per cent. higher than by the Tervoooren method; and for the following two reasons: (1) In many molasses the sucrose content can certainly not be determined within 0.5 per cent. by this latter method; and (2) it is not known with certainty whether Tervoooren's method really gives exact results. In addition to its greater decolorizing power, basic lead nitrate has other advantages over basic lead acetate. An excess cannot cause an alteration of the rotation, nor can it produce darkening, the basic nitrate being slightly soluble as compared with the basic acetate, an excess of which latter reagent dissolves some of the precipitate, altering the rotation, and at the same time darkening the solution.

ALUMINIUM SULPHATE.

This reagent has been used in Hawaii,¹ in place of aluminium hydroxide and acetic acid. The sulphate forms a precipitate with the lead salts still in solution, this finely divided lead sulphate having an appreciably greater adsorbing action than the suspension of aluminium hydroxide. Acetic acid is to remove the effect of the base on the rotation especially of levulose; but this object is also realised by the aluminium sulphate, since in solution it reacts acid.

In the first place it had to be determined whether aluminium sulphate exerted any appreciable influence on the rotation. In doing this, the ordinary method of clarification according to TERVOOREN was compared with a method in which aluminium sulphate was used in place of aluminium hydroxide and acetic acid. In both cases, precisely the same results were obtained.

In comparison with aluminium hydroxide and acetic acid, aluminium sulphate has the following advantages: (1) When the lead salts are present in the liquid in an excess not too great, they are quantitatively precipitated as lead sulphate, so that the formation of a cloudiness is avoided, whereas when operating according to Tervoooren's method after a comparatively short time a white haze appears. Again when a lead-free liquid is used, a precipitate is not formed on adding hydrochloric acid, and all the hydrolysing agent remains active. (2) The purifying effect is greater.² And (3) its application is simpler.

Here follow the results of the analyses in which the use of basic lead nitrate and aluminium sulphate as compared with Tervoooren's method.³ Method A indicates the proposed new procedure; and B, Tervoooren's method.

¹ *Hawaiian Planters' Record*, 1910-11, 334. It was recommended by NÖRL DEER. See *I.S.J.*, 1915, 179.

² With many molasses from defecation factories the clarification with basic lead nitrate was so intense that the filtrates obtained could be read in the 400 mm. tube.

³ Only a few of the results published in the original article are here reproduced.

New Clarifying Agent for the Clerget (Double Polarization) Method.

Method.	Kind of molasses.	Polarization before inversion.	Polarization after inversion.	Temperature.	Sucrose.	Average difference.
A	Defecation	32.25	14.6	27.4	35.8	+ 0.4
B	"	31.68	14.58	27.5	35.4	
A	"	33.12	14.54	27.4	36.4	+ 0.4
B	"	32.68	14.42	27.5	36.0	
A	Sulphitation	29.6	13.45	27.6	32.96	
A	"	29.65	13.45	27.6	32.96	+ 0.45
B	"	29.75	12.75	27.6	32.5	
B	"	29.7	12.8	27.6	32.5	
A	Carbona-	28.25	12.5	26.3	31.01	
A	tation	28.25	12.4	26.3	30.91	+ 0.35
B	"	28.35	11.9	26.3	30.61	
B	"	28.3	11.9	26.3	30.58	

DIRECTIONS FOR THE NEW METHOD.

Reagents.—A saturated solution of the lead nitrate is made by dissolving 600 grms. in 1 litre of water. The alkali is prepared by dissolving 80 grms. of sodium hydroxide in water, and making the liquid up to 1 litre, which solution should have a sp. gr. of 1.075 at 27.5°C., or 10° Bé. at this temperature. In regard to the aluminium sulphate, a saturated solution in water is prepared.

Procedure.—35.816 grms. (the normal weight $\times 5/2 \times 1/2 \times 11/10$) of the sample are introduced into a 250 c.c. flask, 30 c.c. of the lead nitrate solution added, the liquid mixed, 30 c.c. of the alkali solution added, and the liquid again mixed, being then made up to the mark. A 100–110 c.c. flask is filled to the lower mark with the filtrate, and the aluminium sulphate solution added to complete the volume almost to the 110 c.c. mark, the exact adjustment being made with water, after which a little kieselguhr is added, and the liquid shaken and filtered. This filtrate observed in the 400 c.c. tube gives the polarization before inversion; but one should wait before making the reading till the inversion liquid is also ready, both being read at the same time under the same conditions of temperature. In making the inversion reading, 50 c.c. of the filtrate is inverted in a 100 c.c. flask according to the Herzfeld, Steuerwald,¹ or Walker² procedures, adding 1–2 grms. of animal charcoal, making the observation in the 400 mm. tube, and using the following formula for calculation: $\frac{P - I}{A - \frac{1}{t}} \times 100$ in which P and I are the polarizations before and after inversion; A , the constant from Herzfeld's table, if Herzfeld's or Walker's method is used; or from Steuerwald's table, if this writer's method has been followed; while t is the temperature of the liquid after inversion.

Mr. W. C. DICKHOFF, who has been editor of our esteemed contemporary, the *Archief*, during the past 24 years, has retired from this post. Mr. DICKHOFF, though supported by the advice of a Publication Committee consisting of well-known Java technologists, has done much to raise the *Archief* to its present high standard; and on his retirement he received the thanks and good wishes of his colleagues. His place is now taken by Mr. J. H. RITMAN.

¹ *J.S.J.*, 1914, 82.

² *J.S.J.*, 1918, 239.

Dr. Spencer's Rotary Digester for Use in Bagasse Analysis.

The determination of sugar in cane bagasse when using the customary digesters usually presents difficulties through the need of keeping the material in motion while treating it with hot water, motion being necessary to promote maceration and diffusion. Following the digestion the extract must be cooled and without special arrangement this is a slow process. Further, many bagasse tests must be made daily for the proper control of the milling of the cane. To permit attention of the chemist to other duties, it is desirable that the testing of

the bagasse should be carried out as automatically as possible.

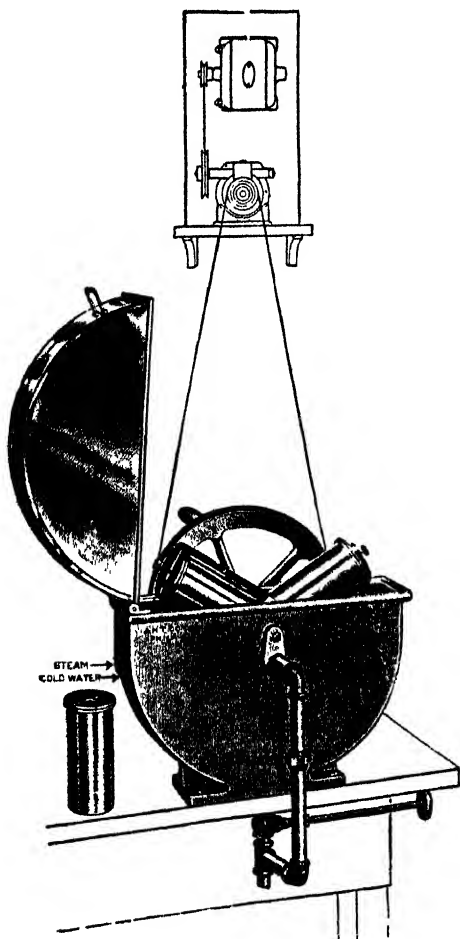
In order to obviate the disadvantages of the usual method of procedure Dr. GUILFORD L. SPENCER, general superintendent of manufacture and chief chemist to the Cuban-American Sugar Co., has devised a special apparatus consisting of a steam-bath in which are rotated three cylinders containing the samples of bagasse and the water. The casing of the digester as shown in the illustration is cylindrical, and is of 24 in. internal diam. A triangular hub, 4 in. long, turns freely with a shaft, which is fitted with an adjustable cone bearing inside the digester casing at one end, while the other end projects through a bronze bearing and carries a pulley 18 in. in diam. The pulley is grooved for a sewing machine belt or a light chain. Clamps are provided on the hub for attaching three aluminium cylinders, 4 in. in diam. \times 8 in. long, for the samples. The clamps also hold the covers of the cylinders in position, which covers have break-vacuum cocks. The pulley is connected through a laboratory reducing gear, 48 : 1, with a small electric motor, and is rotated at about 5 revs. per min.

The cylinders are revolved endwise;

a hinged cover closes the apparatus when in use; and the casing is drained by a 1 in. pipe, provided with a stop valve. A 1 in. overflow pipe leads from a point below the shaft and connects with the drain below the stop valve; while the apparatus is provided with a $\frac{1}{8}$ in. steam pipe and a $\frac{1}{2}$ in. cold water pipe.

The following is the procedure in making a sugar test with this digester: 100 grms. of chopped bagasse are weighed in a tared cylinder; 1 litre of very hot water is

¹ It is sold by the ARTHUR H. THOMAS COMPANY, of West Washington Sq., Philadelphia, Pa., U.S.A. (See Advert. in this issue).



Dr. Spencer's Rotary Digester for Use in Bagasse Analysis.

added; the cover, with the cock closed, is placed in position on the cylinder; and this is then locked on the hub. If ammonia has been used in preserving the material while collecting the sample, no alkali is added to the digestion water; otherwise sodium carbonate is added. The cover is closed, and with the bottom drain open, steam is turned into the casing, but very little is necessary. The cylinders are revolved for an hour in the steam and this is then shut off; the drain is closed; cold water is admitted; and the revolution of the hub is continued until the sample is cooled. Lastly, the drain is opened, and the cylinders removed, dried, weighed, filtered, and polarized.

As may be noted, the slow motion of the hub causes the bagasse to fall from end to end of the cylinder, agitates the extract, and promotes maceration and diffusion.

A Study of the Fundamental Laws of Filtration, using Sugar Refinery Equipment.¹

By FRED P. BAKER, Massachusetts Institute of Technology, Cambridge, U.S.A.

There is at present to be found in the literature very little information that is of immediate value to the designer of the plant filtration unit, when he wishes to determine accurately the size of installation necessary for his purpose. The object of the present investigation was to study some of the factors determining the capacity of a filter press, using commercial-size filters, and to show the applicability of a simple fundamental equation expressing the relationship between rate of flow, pressure, and thickness of cake. It was also purposed to demonstrate the proper way to increase the pressure and also the most efficient filter cycle length. The work was carried out in the plant of the Revere Sugar Refinery, Charlestown, Mass.

DISCUSSION OF THEORY.

From the work of various experimenters, it is safe to say that the rate of flow of liquid through a filtering medium is proportional to some power of the pressure, and inversely proportional to the thickness of cake. It is also proportional to the area of filtering surface exposed. We may express these relationships by the equation

$$R = \frac{C A P^n}{L} \quad (1)$$

where R = rate of flow of liquid,

A = area of filtering surface in sq. ft.

P = pressure in lbs. per sq. in.

L = thickness of cake in in.

C = proportionality constant, depending on the nature of the sludge,

n = constant, also dependent on the nature of the sludge.

Now, in general, the thickness of the cake is, of course, proportional to the volume of cake, which is proportional to the total volume of liquid put through the press at any time, if the sludge is kept thoroughly agitated. Consequently, we have

$$L A = \alpha V$$

where $L A$ = volume of cake,

V = total volume in cub. ft. of liquid filtered at the time when the cake thickness is L ,

α = proportionality constant.

¹ *Jl. Ind. Eng. Chem.* 1921, 13, No. 7, 610-613.

Substituting back in Equation 1 we have

$$R = \frac{CA^2 P^n}{\alpha V}$$

Combining the two constants, C and α , and writing the rate of flow as volume per unit time, the equation becomes

$$\frac{dV}{d\theta} = R = \frac{KA^2 P^n}{V}$$

It has been experimentally shown, however, that the rate of flow, R , does not in all cases vary inversely as the first power of V , although the variation is not large. However, for the general equation, we will take care of such variation by raising V to some power, m , and hence we have

$$\frac{dV}{d\theta} = \frac{KA^2 P^n}{V^m} \quad (2)$$

which is the *fundamental law of filtration*. It is essentially the same equation as that proposed by W. K. LEWIS¹ several years ago.

The equation may be derived directly from Poiseuille's formula for sinuous flow through capillary tubes :

$$K_1 A \pi r^4 P$$

$$8 \mu L$$

where v = velocity of flow
 r = radius of capillary tubes
 K_1 = number of capillaries
 μ = absolute viscosity
 L = length of tubes.

At any given temperature μ is constant, and r is a function of the amount of compression of the cake, which, as will later be shown to be experimentally true, is a power function of the pressure. Hence we may substitute K_2 for all terms except P and L , and the equation is reduced to

$$v = \frac{K_2 P^n}{L}$$

which corresponds to Equation 1, where K_2 includes the term A in Equation 1.

It is important to note that the value of n in our fundamental filtration equation may vary considerably, according to the nature of the solid in the sludge, although it is constant for any particular sludge. We may understand this by a consideration of the cake that is deposited. According to the capillary conception of the flow of the liquid through the cake, there are innumerable small openings, corresponding to capillary tubes running through the cake. Now according to Poiseuille's formula, the rate of flow is proportional to the *fourth* power of the radius of these capillary voids. Consequently, any change in the size of these voids must tremendously affect the rate of flow. Therefore, if we have a suspended solid of such a nature that its particles will be squeezed together to the extent of lessening the size of the capillaries by increasing the pressure of the filter, it is obvious that the rate of flow will not increase directly proportionally to the pressure.

Previous experimental work illustrates this point very clearly. LEWIS and ALMY,² using a chromium hydroxide sludge, which is noncrystalline and easily compressed, found that the rate varied approximately as the fourth root of the

¹ J. Ind. Eng. Chem., 1912, 4, 528.

² J. Ind. Eng. Chem., 1912, 4, 524.

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pressure. In other words, the value of n , the exponent of the pressure, they found to be 0.27. SPERRY,¹ using a suspension of kieselguhr in water, found that the rate varied directly as the pressure, thus showing that, for a noncompressible solid, the value of n is 1.0. In the formula which SPERRY derives, he takes the exponent of the pressure to be 1.0 in all cases, which, as proved by LEWIS and ALMY, and by the results described in this article, is entirely erroneous.

The value of m , the exponent of the volume of filtrate, is undoubtedly somewhere in the neighbourhood of 1.0. LEWIS and ALMY found it to be 0.81 for their chromium hydroxide sludge, and it is probable that the limit of variation is from 0.8 to 1.2.

In order to study the application of Equation 2, we have two types of flow to consider, namely: (1) constant pressure throughout the filtering cycle; (2) constant rate of flow throughout the filtering cycle.

In the first case, with pressure constant, Equation 2 becomes:

$$\frac{dV}{d\theta} = \frac{K_1 A^2}{V^m}$$

On any particular press, A is constant, and hence: $V^m dV = K_2 d\theta$.

$$\text{Integrating: } \frac{V^{(m+1)}}{(m+1)} = K_3 \theta + \text{constant} \quad (3)$$

the constant of integration drops out since when $\theta = 0$, $V = 0$.

Now we have a means of determining whether m is equal to 1.0, since if:

$$\begin{aligned} m &= 1 \\ V^2 &= K_4 \theta \end{aligned} \quad (4)$$

Let $y = V^2$ and $x = \theta$, then Equation 4 is $y = Kx$, which is the equation for a straight line.

Consequently, if we plot V^2 against θ , and the resulting curve is a straight line, Equation 4 is true, and $m = 1$. This must be so, since if m were not equal to unity, but equal, let us say, to 2, then Equation 4 would rightly be

$$V^3 = K_5 \theta,$$

and if we plotted V^2 against θ for such an equation it would not result in a straight line.

In the second type of flow, namely, constant rate of flow, Equation 2 becomes

$$\frac{dV}{d\theta} = \text{constant} = \frac{KA^2 P^n}{V^m} \text{ or } V^m = K_4 P^{n4}. \quad (5)$$

Therefore, from Equation 5 we have a means of determining n , because:

$$m \log V = \log K_4 + n \log P \quad (6)$$

and by plotting $\log V$ against $\log P$ for runs made at constant rate of flow, the slope of the resulting log curve is $\frac{n}{m}$ and knowing m , we find n .

EXPERIMENTAL WORK.

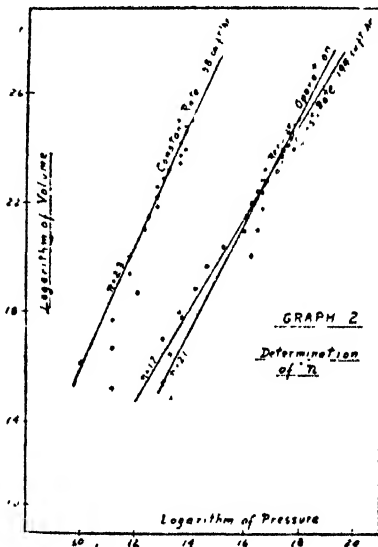
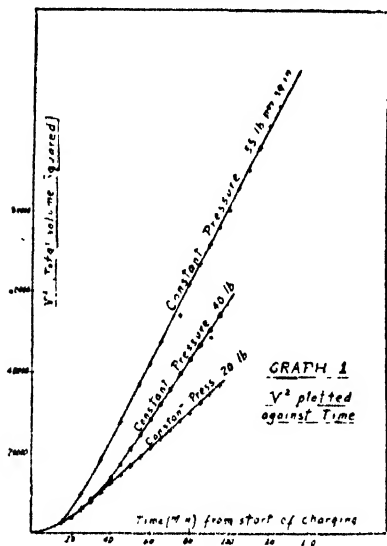
In the experiments herein described, the application of the filter equation to the filtering of defecated sugar solutions by means of standard Sweetland filter presses was studied. The sludge used was that obtained from a raw sugar liquor by the coagulation of albumins, gums, and other organic matter on addition of lime, and by boiling. Kieselguhr is added to the sludge in order to form a lattice work base on the filter cloth, which makes the cake porous. If kieselguhr were

¹ *Chem. Met. Eng.*, 1916, 19, 198.

not added, the slimy precipitate would almost immediately clog up the pores of the filter cloth and prevent filtration.

A copper triangular weir was constructed and placed on the outlet of one of the presses, by means of which the rate of flow of the press was accurately determined. A pressure gauge was placed on the inlet of the press, and the pressure or the rate of flow, as the case might be, was regulated at will by a hand valve between the press and the pump. The latter was of the centrifugal type delivering at a maximum of about 70 lbs. per sq. in.

The tests were made on the press while it was operating on the regular plant schedule, the only change being in the variation of the pressures and rate of flow as needed. The regular cycle of operation was to filter the juice for 1.5 hours, then sluice the cake off with the water sluice without opening the clam-shell, and repeat. The clam-shell was opened once every eight hours for thorough cleansing of the cloths. In these experiments the 1.5 hour cycle was taken for the testing period. Readings of temperature, specific gravity, rate, and pressure were made every five minutes during the test.



For purposes of comparison, one test was made on the press operating exactly under normal plant control, that is, allowing the plant operator to change the pressure and rate of flow as he normally does. This run is described on the graphs as "Regular Operation." It was essentially a constant rate of flow run, as is shown on Graph 3, the volume-time curve being approximately a straight line.

Graph 1 shows the result of plotting V^2 against the time for several runs made at constant pressures, ranging from 20 to 62 lbs. These graphs are all straight lines after a few minutes at the start, during which time the cake has not formed sufficiently to give uniform filtering conditions. As shown in Equation 4, the fact that the square of the volume of liquid does vary as the first power of the time shows that the exponent m of the volume V in the filter equation must be equal, or very nearly equal, to 1.0 for this particular sludge.

Graph 2 shows the method of determining n , the exponent of the pressure term in Equation 2. From Equation 5 it was shown that, for runs made at constant rate of flow, $\log V$ could be plotted against $\log P$, and the slope of the line

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would be $\frac{n}{m}$. Since we have found that $m = 1.0$ for this sludge at least, the slope of the line must be equal to n . For the three runs that are plotted on Graph 2 the values of n are found to be 1.7, 2.1, and 2.3, giving an average value of 2.0.

At first thought this value of $n = 2$ appears entirely inexplicable. It means that the rate of flow of liquid through the filter was proportional to the square of the pressure, and it would seem that the rate could not increase more than directly proportional to the pressure, because of Poiseuille's formula, in which the rate varies directly as the pressure. However, a reasonable explanation can be made of such a value of n by a consideration of the nature of the filter cake. It will be remembered that the sludge contained a very slimy, gummy precipitate, which was mixed with kieselguhr to aid filtration. Now kieselguhr is a substance which is very porous, the microscope revealing a structure similar to coke. We may conceive of the filter cake as built up first of a lattice work of grains of kieselguhr. Then at low pressure the slimy organic precipitate tends to fill up the space between these grains of kieselguhr, as filtration proceeds. But as the pressure increases there is a tendency to force this slimy precipitate into the pores of the kieselguhr, thereby failing to fill up the voids between the grains of kieselguhr as fast as though the base was of a nonporous nature, such as grains of sand. This would allow more free space for the liquid to flow through than was afforded at lower pressure, and hence the rate would be increased more than in direct proportion to the pressure. It is, of course, obvious that this result will be obtained only when two solids are in suspension, one of which will be of a porous nature, such as kieselguhr. Any single solid in a sludge will give a value of n which is less than unity.

Since we have now determined n and m in the equation

$$\frac{dV}{d\theta} = \frac{KA^2 P^n}{V^m}$$

it is possible to calculate K from the data for rates, pressures, and volumes of filtrate, since we know the area of the filtering surface.

USE OF THE FILTRATION EQUATION.

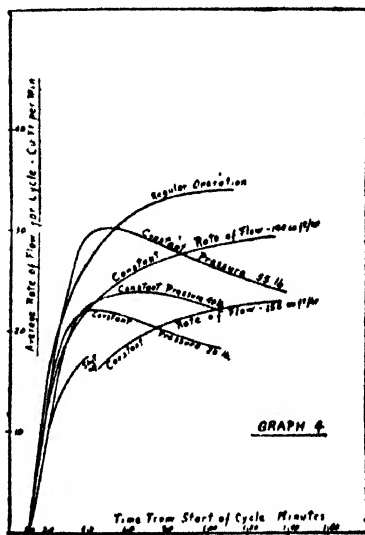
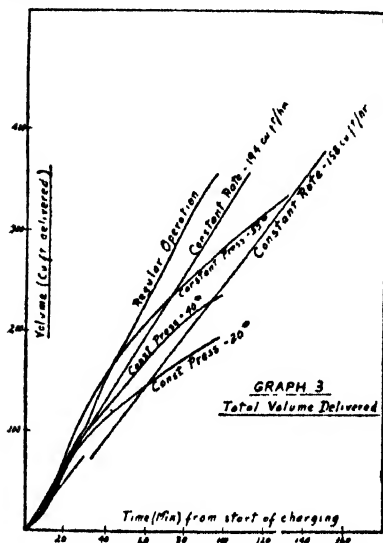
Obviously these values of K , m , and n apply only to this one sludge, precipitated under particular conditions, and of a definite specific gravity and temperature. Hence the numerical values of the constants are of importance at present only to the user of such a sludge. It is easy to see, however, the great value of an extensive accumulation of data on these constants from which comparative estimation of the values of K , m , and n can be made for any particular sludge under consideration.

As noted by LEWIS and ALMY, the real importance of the filtration equation is in affording a means of determining the area of filtering surface required for any definite amount of sludge for which the constants are known. The constants can be determined on a small laboratory filter-press, and from them the size of installation required for the plant can be calculated.

For example, let us say we have made runs on a laboratory press for the sludge to be used. We have determined the constants K , m , and n for the sludge at the temperature to be used in the plant, and we have found the filter area necessary on the small press to give us a certain rate of flow in cub. ft. per hour. Now if we know the amount of sludge to be handled in the plant, and the allowable time for filtration, we can at once calculate the area of filter surface by substituting in the filter equation the proper rate of flow, and solving for the area.

It was also proposed to demonstrate whether it is better to increase the pressure on a filter-press to its maximum at the beginning of a run, and hold it constant, or to run a constant rate of flow, which means increasing the pressure gradually throughout the filtering time. We have plotted two sets of curves which demonstrate clearly the superiority of a constant rate of flow over constant pressure when there is a compressible solid in the sludge.

Graph 3 shows, for several runs, the total volume delivered at any time. It is seen that the "constant rate of flow" curves pass the constant pressure curves, and toward the end of the cycle the volume of filtrate delivered is very markedly greater.



Graph 4 demonstrates in a different manner the same superiority of constant rate of flow. Here we have plotted the average rate of flow at any time t against t . This time is the time from the beginning of sluicing of the previous cake. This sluicing time has been estimated at ten minutes. The average rate of flow is the total volume filtered at time t divided by t , where t is again measured from the beginning of sluicing. This curve indicates the proper length of time for the filtering cycle. On such a press as the Sweetland, the point of maximum average rate of flow is not the point to sluice the press. The decrease in rate of flow as the maximum is passed must be balanced against the labour of sluicing and the extra amount of wash water to be handled. Consequently, the point at which filtration should be stopped will be somewhat to the right of the maximum on the curve. However, Graph 4 shows conclusively the advantage of constant rate of flow, as the constant pressure curves reach their maximum very early in the cycle, and then fall off rapidly, while the constant rate of flow curves have not yet reached their maximum.

These results are most conclusive in showing that the pressure should be increased gradually, and not immediately raised to its maximum, in the filtration of compressible solids. Initial high pressure forces the precipitate into the pores of the filter-cloth and forms a layer through which it is very hard to force the liquid. This does not apply to noncompressible solids, such as sand, where the pressure can be increased at will, up to the limit of the strength of filter-cloth.

Noël Deerr's "Cane Sugar."

An Entirely New Edition.*

Deerr's well-known work dealing with the agriculture of the cane, the manufacture of sugar from the cane, and the analysis of sugar-house products has now been completely re-written, excepting only the chapter on fermentation, and portions of the sections dealing with manuring, husbandry, analysis, and chemical control. It is, in effect, *an entirely new edition* in respect both of subject matter and of two-thirds of the illustrations (which now include 12 coloured and 19 ordinary plates, and 360 drawings and charts). However, the general arrangement of this comprehensive book, which justified itself in the case of the previous edition, is still preserved. But as the new work contains nearly 25 per cent. more matter than the first edition did, the opportunity has been taken to produce a more compact volume by the use of closer type and thinner paper. The result is a lighter and thinner book which cannot fail to be advantageous to the student generally.

Since the publication of the 1911 edition, much good progress has been made in sugar production in various directions and in different countries, and since that year also the author has added to his already extensive experience. In the light of this progress and wider experience, the volume has been carefully revised; and the result is a remarkably exhaustive treatise, which, while exposing with a sufficient amount of detail the scientific principles upon which the production of sugar in its different aspects depends, still remains a practical work, full of original information regarding modern methods of cane cultivation, modern machinery, and the latest chemical data.

During the time spent by the author in America, the opportunity was afforded of examining the collections of technical literature to be found in the great libraries of the western republic. This is reflected throughout the volume in many places, as in the systematic presentation of our knowledge of cane varieties and cane diseases and pests, and in the statement of the development of invention relating to machinery and processes, more especially in connexion with milling and evaporation.

Deerr's earlier issue of "Cane Sugar" obtained the distinction of being regarded as the standard work on the production of cane sugar. That this new edition will enhance the reputation previously acquired, and that the work will still be regarded as the indispensable textbook for the agriculturist, the engineer, and the chemist engaged in the cane sugar industry, there can be little doubt.

In order to assist the reader in arriving at an estimate of the value of the book, three specialists have been invited critically and impartially to record their impressions regarding it from the standpoint respectively of (1) the agriculturist, (2) the engineer, and (3) the chemist. The first of these reviews here follows, and the other two will appear in later issues of the *Journal*.

AGRICULTURAL SECTION.

Those portions of "Cane Sugar" dealing with the botanical and agricultural sides of the cane sugar industry are usually extremely interesting reading, though necessarily they show some inequalities dependent on the degree of information

* CANE SUGAR. By NOËL DEERR, Fellow of the City and Guilds of London Institute. Second Edition (revised and enlarged). viii + 644 pages Royal 8vo.; 30 Plates (12 coloured) and 360 illustrations in text. (Norman Rodger, 2, St. Dunstan's Hill, London, E.C. 3.) 1921. 42s. net.

available to the author either from literature or from his own experience. His extraordinary industry is especially obvious in the chapters on Range and Climate, Cane Varieties, and Pests and Diseases, all of them valuable contributions to the knowledge of the life of the cane plant. The literature on these subjects is copious, especially in the last two, and Mr. DEERR had evidently made full use of the great facilities afforded by the American libraries. The pests and diseases of the cane are treated very fully, and their presentation is eminently successful, although we doubt the fitness of reprinting the Latin descriptions of many of the fungi in a work intended largely for reference among actual workers in the field.

On the cane varieties the author has much to say, and is a recognized authority. The long chapter dealing with these is a well-arranged résumé of this intricate subject, and shows a vast amount of laborious research among the forgotten files of by-gone times. On reading the chapter through one soon realizes that it is no mere compilation, but includes a great deal of personal observation carried on for many years. This is especially the case with the inextricable tangle of the synonymy of the "traditional" cane varieties which have played so large a part in the history of the industry. Some of these canes are illustrated in a series of beautiful coloured plates, three of which are new to this edition.

On the other hand, we do not think that the opening chapter, on the structure of the cane plant and its tissues, is so successful. In the first place, it was an impossible task to treat of this important section in so short a space, allowing for the figures, less than seven pages. The figures are generally excellent and are mostly borrowed.¹ But they are of unequal value: Fig. 4 (a cross section of a leaf) is a work of art, but is spoilt by the inclusion of the elaborate and wearying description of its author: Figs. 5 and 6 (the upper and lower surfaces of the leaf) are scrappy and ineffective, and this defect is not mended by their being dismissed with three lines of letterpress which will rather puzzle the ordinary botanist. Then, in Figs. 10 and 11 (showing longitudinal and transverse sections of the root), *m* and *st* do not accurately indicate the meristem and central cylinder (stele) respectively. We note that the author divides the plant (beyond the leaves) into stalk and root system, and in the latter includes the underground rhizome and the fibrous roots; the usual division in all plants is into stem and root, and we do not think that there is any reason to deviate from it, in favour of the parts above and below ground.

The other agricultural chapters, those on manuring, irrigation, husbandry and harvesting, all contain much interesting matter; they are, it is true, the sections that show the least variation from the older book, but this is inevitable since here there is the least progress to record, procedure in these branches being more largely stabilized. All the same, the author has managed to give the results of more recent experience in various respects, e.g., the return of plant residues to the soil, yields of sugar to the acre, weed destruction, etc., and a number of more modern implements are illustrated.

From all this, we consider that the presentation of the biological side of the cane industry by Mr. DEERR is a notable achievement, in spite of some minor defects, incident on the impossibility in such a comprehensive survey of attaining perfection in all directions.

¹ One would assume that Figs. 9 to 11 are the author's own, for there is no reference to their having been obtained elsewhere; but according to the first edition of this work, they originated in U.S.P.A. publications and were prepared under the direction of Dr. COBB.

Publications Received.

Organic Chemistry for Advanced Students. Part III, Synthesis. By Julius B. Cohen, F.R.S. Third Edition. (Edward Arnold, London, W.) Price: 18s. net.

We are pleased to draw attention to the publication of the third edition of Dr. Cohen's well-known book on Organic Chemistry, especially for the reason that it contains an excellent statement of the present position of our knowledge of the chemistry of the carbohydrates. A very clear and interesting account is given of the structure, sources, and synthesis of the monosaccharides; the configuration of aldoses and ketoses; the structure and synthesis of the disaccharides, etc., etc. In this volume there are also chapters on fermentation and enzyme action and on the proteins. Dr. Cohen's book furnishes a general survey of those fundamental principles which underlie the modern developments of this branch of chemistry, and we are glad to recommend it to those desiring to acquire such knowledge.

Recent Advances in Organic Chemistry. By Alfred W. Stewart, D.Sc. Fourth Edition. (Longmans, Green & Co., London and New York) Price: 21s. net.

Dr. Stewart's very helpful books are now well-known and appreciated among chemists. The one before us summarizes the work done in the main branches of organic chemistry during the past ten years or so; and is an interesting exposition of the principles upon which the science is developing. It discusses the chlorophyll problem and theories of the natural synthesis of vital products; while Dr. NORMAN COLLIE has collaborated in contributing a critical examination of recent work done on the methods by which natural products, as carbohydrates, proteins, and pigments, may possibly come into existence in the organism.

Die Schaumabscheider [Froth Separators]. Hugo Schröder. With 86 illustrations. (Verlag von Otto Spamer, Leipzig). 1918. Price: M. 7.50, plus 40 per cent.

In the main the author deals with the design, the action, and the power consumption of those many types of separators which from time to time have been proposed for use in connection with evaporators for freeing the evolved vapour from juice particles. His net conclusion from his considerable practical experience is that the most efficient apparatus are included among those constructed on the principle of air-craft, that is, appliances depending upon centrifugal force for the removal of the fine spray or foam. This is a similar conclusion, it will be remembered, to that arrived at by Dr. HAAN,¹ as the result of careful tests made in Java on entrainment during evaporation.

Sugar Beet Pulp as a Stock Food. Compiled by Alfred Wood. (The British Sugar Beet Growers' Society, Limited, 14, Victoria Street, Westminster, London, S.W. 1.) 1921.

Mr. WOOD has collected in the form of a pamphlet evidence, mostly from American sources, of the value of beet slices for the feeding of live stock.

A new edition of "The Manufacture of Cane Sugar," by JONES and SCARD, is now in the press, and will be ready at the end of this month. This second edition has been thoroughly revised and brought up-to-date, though written on the same lines as the first issue. On its publication fuller details will be given in this *Journal*.

¹ I.S.J., 1921, 95-96.

Trade Notices.

Fulton Milling Installations. Bulletin No. 101 of 1921. (Fulton Iron Works Company, St. Louis, Mo., U.S.A.).

This interesting Bulletin shows about 24 photographs of some of the Fulton installations now operating in Cuba, among whose factories are some of the largest and best equipped in the world. Comparative grinding statistics are also presented, showing how each additional Fulton unit has increased the efficiency of the milling in some of the best-known centrals in that country. In the section dealing with double crushers there appears a particularly good "close-up" photograph showing in a very clear manner the effect of this apparatus upon the disintegration of the cane, by means of which it is split and crushed into a uniform blanket. It is emphasized that the Fulton rolls with their permanent open-grain gripping surface and coarse-pitch grooving do not cut the cane into small pieces, but split and tear the rind, permitting thus the exit of the juice from the innermost cells. Triple crushers have been installed at Central Manati, and the results showing to what extent this innovation will prove successful should shortly be available. Manati has sixty 36 in. x 84 in. rolls in her total milling installation, which now has the distinction of having the largest capacity in the world. Central Tuinucú ground with its Fulton equipment during 1919-20 at the rate of 101 tons per hour with an average maceration of 22 per cent., the sucrose extraction averaging 94.41 per cent., and the normal juice extraction 81.68 per cent., while the moisture in the bagasse was 47.36 per cent. This Bulletin should be found of much value to sugar manufacturers, giving as it does an insight into the most up-to-date milling practice. It is obtainable by all interested gratis by writing to the main office of the Fulton Iron Works Co., at St. Louis, Mo., U.S.A.

Chemical Engineering Catalog. Sixth Edition. (The Chemical Catalog Co., 1, Madison Avenue, New York, U.S.A.).

At the time of the publication of its previous editions, we pointed out the valuable nature of this compilation. It consists mainly of condensed illustrated catalogue data of manufacturers in the United States catering in any way for the chemical industries, and in fact consists of a "room-full of individual catalogs, abstracted, indexed, and assembled within the cover of a single book." It is a book which should be in the hands of the technical chemist, if only for the succinct descriptions and clear illustrations of the plant now used in the principal industries with which he may be connected. By many others it will be found highly serviceable as a well indexed list of suppliers of the machinery and raw materials used in the arts and manufactures employing chemical processes in some way or another. A very complete list of technical and scientific books on chemical and related subjects is now included, and in the section dealing with our own industry we find this is both complete and up-to-date. This 6th edition now appears in a soft artificial leather binding, but it is doubtful whether in the case of so heavy a book this alteration will prove to be an improvement when heavy wear is demanded. The Catalog is leased at \$2.00 a copy for the period of one year to chemical engineers of responsible position, and 11,500 copies will be distributed.

LEFAX (INC.) is an organization issuing a loose-leaf service of data of much value to technical and business men. Its editors are constantly engaged in making a digest of articles in periodicals, proceedings of societies, and other publications, which are "boiled down" to a convenient compass. These abstracts are printed on loose leaves of standard size, which may be carried in a convenient pocket-book until read, and later filed, each sheet being already indexed and classified according to a system realizing ready and certain reference when required. "Data sheets" are arranged according to the following groups: general, civil, mechanical, and electrical engineering; chemical, mining, costs, and military. Moreover, data compiled personally from one's own reading or observation may be recorded on blank perforated sheets supplied in the standard size, and these filed with the printed matter. In addition, a "Pocket Magazine" is published giving digests of articles and data of a more general interest than the classes above mentioned. Full particulars with sample sheets will be sent by Messrs. Norman and Hill, Ltd., 50, Sun Street, Finsbury, London, E.C. 2, who are the sole distributors in the United Kingdom for this very useful loose leaf service. Engineers and chemists attached to the sugar industry will be well advised to avail themselves of this efficient service for the supply of the latest technical data.

Brevities.

Dr. J. F. BREWSTER has been appointed research chemist at the New Orleans Experiment Station, in place of Dr. F. W. ZERBAN, who formerly held this appointment. Dr. W. L. OWEN has returned to the same Experiment Station to resume his bacteriological work.

It is reported that a new German sugar trust, embracing all the refineries and 98 per cent. of the raw sugar producers has been formed. The aim of the trust is stated to be to ensure a common policy in the restoration of freedom in trading in sugar. But any attempt to resuscitate the pre-war type of Kartell, with its bonus on export and high inland prices for sugar, will have to be watched for and promptly met by any other States affected.

Bagasse is being utilized in Louisiana for the manufacture of a boarding by being incorporated with a suitable binding agent, the nature of which is not divulged. This boarding is known as "Celotex." It is very light and is waterproof, a box made of it holding water indefinitely. It can be handled as ordinary lumber, and be sawn to any dimension required. It resists decay, and forms a building material highly recommended on account of its insulating qualities for the construction of buildings in the tropics.

After an exhaustive investigation of conditions in the Philippines, General LEONARD Wood, the American Government representative, has reported that these islands are not yet ready for independence. He has recommended the establishment of better communications, and improved educational facilities. Probably the final decision of the United States will be based on their military and naval requirements. So long as the Philippines possess important strategical advantages for the U.S.A., their retention in one form or another will undoubtedly be continued.

Trials recently made with the Martel filter at Penick & Ford's Dora plantation, Avoyelles parish, Louisiana, are reported to have given satisfactory results. Blackstrap molasses having a high gum content was diluted to the gravity of cane juice, and mixed with filter-press mud from the previous crop, thus making a mixture which ordinarily would be very difficult to filter. It is stated that with the Martel filter this was accomplished "perfectly." It is claimed that this apparatus may be used for the filtration of the entire juice for the elimination of the colloids, thus obviating the necessity of using lime and sulphur.

A variety of sugar cane known as Shahjohanpur No. 10 was received some time ago by the Queensland Bureau of Sugar Experiment Stations from India, being recommended as a cane which would withstand cold weather. This cane was planted out at the Bundaberg Station, where it was found to resist severe frosts remarkably well. Its sugar content and cropping qualities being good, it was ultimately distributed to a considerable extent in Southern Queensland, where there are now large blocks of it under cultivation. A recent analysis of the variety at Bundaberg gave this result:—Brix, 21.7; purity of juice, 91; percentage of fibre in cane, 13.6; commercial cane sugar, 15.05

Prof. E. C. C. BALY, F.R.S., in his recent address to the British Association, Edinburgh, in discussing the synthesis of sugars by the plant from carbon dioxide and water said that he and his associates had produced formaldehyde by exposing an aqueous solution of carbon dioxide to ultra-violet light of short wave length. This synthesis cannot occur in sunshine, owing to short wave length radiation being absent through absorption by the atmosphere; but the possible explanation of its occurrence is to be found in photo-catalysis, viz., the re-absorption of the radiated energy. Chlorophyll acts as the catalyst by absorbing visible light and radiating it at frequencies which could be re-absorbed by the carbon dioxide and water. Other substances, such as malachite green, methyl orange, colloidal uranium and ferric hydroxides are also capable of acting as photo-catalysts in this way. Further, he had effected the polymerization of formaldehyde to sugars by a similar photo-catalytic process. In the living plant it is very doubtful whether the process of the synthesis of the sugars goes through the stage of formaldehyde at all. It is much more likely to proceed in one stage.¹

¹ A full account of this interesting work is to be found in the *Journal of the Chemical Society*, 1921, 119, 1025-1035.

Review of Current Technical Literature.¹

IMPROVEMENTS IN THE DESIGN OF REFRACTOMETERS FOR USE IN THE SUGAR INDUSTRY.

A. Herzfeld. *Sonderschrift der Deutschen Zuckerindustrie*, 1921, 55.

There were two disadvantages connected with the old Abbe refractometer, namely : (1) that it was very difficult to examine dark liquids by transmitted light alone ; and (2) that the scale was engraved with the refractive index values ; but both of these have been



FIG. 1

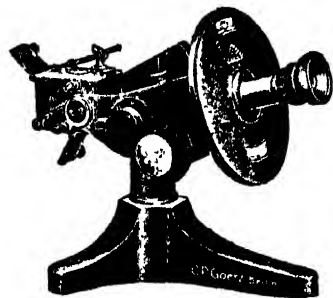


FIG. 2.

overcome, while, moreover, the use of Schönrock prisms instead of the Amici device has somewhat lowered the cost of the instrument. Good service has been rendered by M. PAUL, who introduced the use of reflected light for the examination of very dark liquors and molasses ; and by F. LÖWE,² who was the first to construct an instrument having a scale indicating directly the dry substance as sugar up to 95 per cent. In the new Zeiss model designed by BAUERSFELD (Fig. 1) several improvements have been embodied. For example : (1) it is now possible for the observer to keep his head in an upright position when taking readings, the form of instrument resembling a microscope being abandoned at the suggestion of Prof. HERZFELD in favour of that now depicted, which is considered less liable to cause eye strain ; (2) using the left hand, adjustment is effected by the screw-head R, while the right remains free for recording the readings ; (3) the scale is divided from 0 to 50 in fifths, and from 50 to 95 per cent. in tenths (or, if desired for use in invert sugar manufacture, as far as 97.5) ; and (4) with clear juices the light from the mirror S is thrown through the window F, and with dark liquors through the funnel-shaped opening T (for measurements by reflected light). In order to open out the prisms, the handle G is swung back, so that the button A rests on the spring-buffer A₂, both prisms then lying in one plane in a convenient position for easy cleaning. An improved refractometer has also been designed by the firm of C. P. GOERZ. It also makes use of the Schönrock principle

of multiple prisms, and it is arranged at an angle (see Fig. 2), being placed either on a low tripod (as shown) or on a high one. It is equipped with two scales : the first reading the dry substance as sugar directly up to 95 per cent. (at either 20 or 28°C.), and the second the refractive index.

ANALYSIS OF SODIUM HYDROSULPHITE. M. J. Harnist. *Colour Trade Journal*, 1921.

Directions are given for the estimation of the more important impurities which may be present in commercial samples. Chlorine is determined by precipitation in the usual way as chloride, after complete oxidation of the hydrosulphite with sodium peroxide ; zinc as sulphide, which is titrated with N/10 iodine ; calcium as oxalate, after the removal of the sulphur in an acid solution ; iron as hydroxide, also after filtering off the sulphur ; total sulphur, as barium sulphate, after oxidation by means of bromide ; and total sodium as sulphate by evaporating down with sulphuric acid. Actual hydrosulphite is ascertained by means of standard indigo solution.

¹ This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*)

² *Zeitsch. f. Instrumentenkunde*, 1913, 23, 305 ; *Vertragszeitschrift*, 1913, 63, 231.

Review of Current Technical Literature.

PREPARATION OF ACTIVATED (DECOLORIZING) CARBON. E. G. R. Ardagh. *Journal of the Society of Chemical Industry*, 1921, 40, No. 19, 230-233T.

This is an interesting review of our present knowledge of the subject. A number of experiments were made by the author,¹ using for the carbonizations an iron pipe, 9 in. long and 2 in. diam., heated in an electric furnace capable of giving any desired temperature up to 950°C., provision also being made for passing a current of gas over the material undergoing treatment. His results, in general, do not differ much from those obtained by ZERNAN,² but the following points may be noted: (1) that impregnation of the sawdust of hard maple (*Acer saccharum*) with ammonium magnesium chloride, or its intimate mixture with calcium phosphate in the proportion of 1:1, gave carbons practically identical with "Superfiltchar" (a preparation of very high power³), in respect of capacity for adsorbing caramel from its aqueous solutions; and (2) that whether or not the sawdust had been impregnated with inorganic salts or oxides, treatment of the char obtained with hydrochloric acid increased its adsorptive capacity for caramel. Some observations and suggestions, which may prove of value to other workers in this field, are made. Thus, it was noticed that when the sawdust is soaked in a solution of a soluble impregnating agent, the salt on drying is transported to the surface of each particle of wood, where it is left as a deposit, so that apparently only a portion of the particles is activated. Therefore, one might expect that increasing the fineness of subdivision of the material before carbonizing would give a more active carbon, since the area of the surface activated would seemingly be increased. Another method of procedure which might be tried is to impregnate the sawdust with a soluble salt, as calcium chloride, and then precipitate calcium phosphate within the particles by subsequent impregnation with a soluble phosphate. It will be remembered that according to Chaney's theory,⁴ when carbonaceous matter is heated, "active carbon" is first formed if the temperature of composition is low enough, but that later this active carbon is inactivated to a greater or less extent by adsorbing some of the hydrocarbons formed in the distillation process, forming a very stable complex.

Mineral impregnating agents assist in breaking down the stable complex. An efficient carbon, made during the war by the United States Chemical Warfare Service and known as "Batchite," was produced by removing from anthracite as much of the adsorbed hydrocarbon as possible by a process of heating at an optimum temperature in an atmosphere of steam, thus bringing about a selective oxidation and distillation as a result of which the active carbon was freed from at least a part of the blanketing substance. Another suggestion here made is that magnesium carbonate should be precipitated within the particles of sawdust, so that during carbonization carbon dioxide should be evolved at a very opportune time, namely, during the formation of the "active carbon," thus assisting in removing the hydrocarbon vapours from the neighbourhood. Or a brisk current of nitrogen, or other inert gas, should prove very effective. Other matters mentioned in this article (which hitherto have not been referred to in the *Journal*, but appear of some interest) concern the papers by LAMB, WILSON, and CHANEY on gas mask carbons,⁵ by WICKENDEN and HASSLER on a rapid method of determining decolorizing efficiencies,⁶ by DORNEY on the development of activated carbon,⁷ by LEISEGANG on charcoal adsorption,⁸ and by COPISAROW on the allotropy of carbon.⁹ Lastly, Prof. ARDAGH remarked that the United States military authorities have set a splendid example in giving to the world the results of these war-time investigations; and that it is to be hoped that the other belligerent nations will shortly profit by this excellent example.¹⁰

¹ Professor, Faculty of Applied Science, University of Toronto.

² *I.S.J.*, 1919, 36, 284; 1920, 90.

³ *I.S.J.*, 1921, 458.

⁴ *I.S.J.*, 1920, 229.

⁵ *J. Ind. Eng. Chem.*, 1919, 11, 420-433.

⁶ *Ibid.*, 1918, 8, 518.

⁷ *Ibid.*, 1919, 11, 282-287.

⁸ *Chem. Zett.*, 1920, 44, 89.

⁹ *Chemical News*, 1919, 118, 301-304.

¹⁰ This expression of opinion we endorse. It is known that wonderfully efficient carbons were produced in England during the war, especially latterly; and it is believed that these were made by economical processes of working, probably by the use of steam, or inert gas, obviating the addition of costly impregnating agents, and the use of hydrochloric acid for the final purification.—EDITORS, *I.S.J.*

KALSHOVEN'S METHOD FOR THE DETERMINATION OF FINE GRAIN IN FINAL MOLASSES.

N. Schoorl. *Archief*, 1921, 29, No. 31, 1055-1059.

It has been stated by DĚDEK¹ that a likely source of error in Kalshoven's method is the contraction occurring on diluting the molasses for the solution of the fine crystal; but Mr. SCHOORL here shows that another reason may well account for the suspiciously high results that have been obtained.² He operated upon a beet molasses (containing 10 per cent. of ash); made a number of gradually increasing dilutions; and determined the refractometric dry substance of each with the results given in the following table, the "apparent grain content" being at the same time calculated by means of the formula used by KALSHOVEN, namely, $\frac{100(p - q)}{100 - q}$, in which p is the dry substance after dilution, and q that before the addition of the water. Before dilution the Brix of the molasses was 76.9°.

MOLASSES IN THE DILUTION.		REFRACTIVE INDEX AT 20° C.		DRY SUBSTANCE PER CENT.		DIFFERENCE, $p - 76.9$.		APPARENT GRAIN CONTENT
100	..	1.4824	..	—	.	—	..	—
81.05	..	1.4481	..	77.4	.	0.5	..	2.2
64.4	..	1.4200	..	77.7	.	0.8	..	3.5
49.1	..	1.3962	..	77.8	.	0.9	..	3.9
31.4	..	1.3714	..	78.1	.	1.2	.	5.2
24.05	..	1.3620	..	78.4	.	1.5	..	6.5

Although actually this sample was free from any crystal, yet according to Kalshoven's method a grain content increasing from 2.2 to 6.5 per cent., according to the dilution, was indicated. This result could not have been due to the contraction of the solution on dilution, because if this had occurred, a higher refraction would have been shown than without contraction. In seeking the explanation it must be borne in mind that molasses is an impure solution, whereas, for obtaining the result from the corresponding refractometric index, tables constructed for pure solutions of sucrose are used. It is the influence of the salts on the refraction that disturbs the results obtained on dilution. If, for example, a 70 per cent. solution of potassium acetate be diluted with an equal weight of water, it will be found that the sucrose content corresponding to the refractive index observed corresponds, not to 35 per cent., as it would have done had it been a solution of pure sucrose, but to 40 per cent., making the apparent sucrose content 80 per cent., that is, a difference of 10 per cent., amounting according to Kalshoven's formula to a "grain content" of 33 per cent. It follows, therefore, that so long as a table constructed for pure sucrose solutions be used for ascertaining the sucrose content of dilutions of molasses from the refractometric index, an error will always result; and the greater the dilution, and the higher the salt content of the molasses, the greater will be the error, and the greater also the "apparent grain content" when Kalshoven's formula is applied.

A METHOD OF ESTIMATING PHENYLHYDRAZINE VOLUMETRICALLY, AND ITS APPLICATION TO THE ESTIMATION OF PENTOSANS AND PENTOSE. Arthur R. Ling and D. R. Nanji. *Biochemical Journal*, 1921, 15, No. 4, 466-468.

Furfural is often determined by precipitating it as phenylhydrazone; but this method has the disadvantage that the hydrazone which is weighed is difficult to dry, its m.p. being below 100° C. This objection is overcome by the authors by estimating volumetrically the excess of phenylhydrazine required to precipitate the hydrazone, the procedure as applied to the determination of a pentose being as follows:—After distilling the sugar with 12 per cent. hydrochloric acid until the reaction to aniline acetate paper ceases (the flask being heated in a bath of sulphuric acid, instead of by a direct flame), the distillate is made up to 250 c.c.; of this 25 c.c. are transferred to a 100 c.c. flask, a drop of methyl orange added, and the hydrochloric acid neutralized with 3N sodium hydroxide, avoiding any rise of temperature while doing so. Then the solution is acidified slightly with

¹ I.S.J., 1921, 327.² See SCHWEIZER, *De Suikerindustrie*, 1920, 20, 1.

Review of Current Technical Literature.

acetic acid, and 10 c.c. of a standardized aqueous solution of phenylhydrazine (approximately 2 per cent.) added, the volume completed almost to the mark (to diminish the surface exposed to atmospheric oxidation), and the flask corked and kept in a water-bath at 50–55°C. for about 20 mins., when the precipitation is complete. After cooling the solution, and completing its volume exactly to 100 c.c., it is filtered through a hardened paper. Lastly, the excess of phenylhydrazine is determined in an aliquot portion of the filtrate. Into a flask is measured 10 c.c. of N/10 iodine solution; 10 c.c. of the filtrate added; the liquid diluted with water to about 100 c.c., and the excess of iodine titrated with N/20 sodium thiosulphate, the volume in c.c. being denoted by the symbol F . The titre of the original phenylhydrazine solution is ascertained in an exactly similar manner, the number of c.c. of N/20 thiosulphate used being stated as X , when the c.c. of thiosulphate equivalent to the furfural is $X - F$. Results obtained by this method were found to be in close agreement with those given by the phloroglucinol process, using both arabinose and the extract obtained by hydrolysing some Indian grasses with sulphuric acid.

MAIZE, ITS CONTENT IN SUGARS, AND ITS YIELD OF ALCOHOL ON FERMENTATION.
P. Viellard. Bulletin agricole de l'Institut Scientifique de Saigon, 1920, 2, No. 4, 106–108.

In five different samples of maize cultivated in Saigon, Cochin China, the total sugars (sucrose and reducing sugars) were found to be 9.04, 9.13, 8.78, 9.75 and 13.38 per cent., corresponding to a theoretical yield of 100 per cent. alcohol of 5.51, 5.58, 5.36, and 8.16 per cent. Regarding the yield per hectare, 20,000 kg. of stalks were obtained, which with a content of total sugars of 10 per cent. corresponds to 2000 kg., equal to 1000 kg. of 100 per cent. alcohol, loss in manufacture being taken into account.

INDUSTRIAL SYNTHESIS OF ALCOHOL. *J. D. La Revue des Produits chimiques, 1921, 24 149–153.*

A useful review of the several processes proposed, giving probable cost figures of some of them.

BRITISH AND GERMAN VOLUMETRIC LABORATORY GLASSWARE. *Sir J. E. Petavel. Nature, 1921, 107, No. 2688, 297–298.*

Flasks, pipettes, and burettes, some of British and some of German manufacture, were purchased by an independent party from various firms who were unaware that the apparatus was destined to be tested at the National Physical Laboratory, Teddington. The results which are here tabulated show the calibration of the British made glassware to be very satisfactory. Of 20 pieces examined, only 5 had capacity errors in excess of the B Class limits (pipettes, 50 c.c. + 0.06, 25 c.c. + 0.045, 10 c.c. + 0.03; flasks, 250 c.c. + 0.15; and burettes, 50 c.c. + 0.07); and of these, four had errors only slightly in excess of the B Class limit. On the other hand, the results for the German apparatus showed clearly that their reliability of graduation cannot be accepted on trust.¹

BEET LEAF-BEETLE AND ITS CONTROL. *F. H. Chittenden. Farmers' Bulletin, No. 1193, U.S. Department of Agriculture.*

In the Rocky Mountain States of America the sugar beet cultivation is menaced by the presence of the beet leaf-beetle (*Monoxia punctuicola* Say.; family Chrysomelidae, order Coleoptera), both the larva and beetle stages injuring the foliage, especially of the young plants. A description is here given of this pest. In regard to control measures, neither dusting nor spraying with arsenicals and other insecticides have given very satisfactory results. Taking advantage of the fact that the beetles pass the winter in alkali areas under tufts of grass, dead weeds, and other rubbish, it is possible by burning these during the winter to effect destruction in great numbers. In order to carry out this scheme, traps consisting of heaps of weeds or bunches of straw or hay should be set up, to be burnt later when the beetles have gone into hibernation.

¹ See also *Journal of Glass Technology*, 1917, 153.

ENTRAINMENT OF JUICE DURING EVAPORATION AND BOILING AS THE CAUSE OF HIGH UNKNOWN LOSSES. *W. C. Nieboer. Archief, 1920, 28, No. 44, 1889-1891.*

A further contribution to this question is now made. It confirms the statement made by J. S. DE HAAN¹ that the high unknown loss of sucrose recently observed in Java is not caused by the "atomization" of the juice, as SCHWEIZER, VAN HAM, and OLSEN² believe; but is due, after all, to the entrainment of juice spray during evaporation. By means of experiments conducted in the Bandjardawa factory, Java, Mr. NIEBOER was able to check entrainment by the use of the whirling-blade type of spray separator, already mentioned by DE HAAN.³ Small pipes ($\frac{3}{8}$ in. in diam.) were inserted into the bottom part of the vapour lines of the last vessel of the evaporator and certain of the vacuum pans, and the liquid drawn off was analysed. When the old Hodek type of "catch-all" was in use, this liquid was found to have a polarization of 2.6°; whereas, when the new apparatus was installed, a reading of only 0.16° was obtained. Regarding the unknown loss of sucrose during manufacture (when both juice and molasses were weighed with care by means of an Adam machine), this was found to average 4.07 per cent. for 1918 and 1919, when the old type of apparatus was in use; but 2.65 in 1920, when two new separators had been put into operation in the evaporator and some of the pans, a saving equivalent to about 2495 piculs (152 tons) of white sugar on a crop of 175,708 piculs (10,768 tons) being realized, the value of which at f. 30 = f. 67,350 (nearly £6600 at par). These two separators, including some alterations to the calandria of the fourth vessel of the effect, had cost only f. 6300 (about £520). It is now intended to equip the entire evaporating and boiling plant with the whirling-blade separator, and it is expected that the result of this improvement will be to reduce yet further the figure indicating the "unknown loss" occurring during manufacture.

ATTITUDE OF THE NEW YORK SUGAR TRADE LABORATORY ON THE NEW BUREAU OF STANDARDS VALUE FOR STANDARDIZING SACCCHARIMETERS. *C. A. Browne. Journal of the Association of Official Agricultural Chemists, 1921, 4, No. 3, 334-335.*

BATES and JACKSON⁴ have found that the value established by HERZFELD⁵ and SCHÖNROCK⁶ for the standardization of the saccharimeter (now generally accepted) is inexact⁷; but the Directors of the New York Sugar Trade Laboratory after careful consideration of the question voted unanimously against the adoption of the new value for the following reasons: (1) That the new Bureau of Standards value has been criticized by European investigators⁸ and until it has been confirmed in other countries and has been agreed to internationally, it would be exceedingly unwise to adopt a value which might have to be changed again to something else, any departure in methods or standards being undesirable unless the proposed changes have a fair prospect of permanency, especially in international transactions, otherwise the sugar trade will be subjected continually to disturbances of this kind. (2) Granting that there may be a slight error in the present German standard, and that the new Bureau of Standards value is correct, no injustice is being done at present to the sellers of raw sugar for the reason that the minus error due to scale graduation is offset by an equal or greater error due to the volume of the lead precipitate in clarification. Dr. BROWNE adds that if a scale error exists it should by all means be corrected, and the true value fixed by international agreement. When this error has been corrected, the counter-balancing error produced by the lead precipitate should also be corrected, either by the application of dry defecation, as proposed by Dr. HORNÉ,⁹ or by some other means. It is added that the above decision of the Laboratory is in complete agreement with the opinion of Dr. PRINSEN GRENELIGS and other European authorities.

¹ *I.S.J.*, 1921, 95.² *I.S.J.*, 1920, 706.³ *Loc. cit.*⁴ *I.S.J.*, 1917, 380.⁵ *Verzeichnisschrift*, 1900, 862.⁶ *Ibid.*, 1004, 521.⁷ See also *I.S.J.*, 1921, 588.⁸ *I.S.J.*, 1919, 520.⁹ *I.S.J.*, 1919, 406.

Review of Current Technical Literature.

EXPERIMENTS ON THE RECOVERY OF THE FINE GRAIN PRESENT IN FINAL MOLASSES.

W. D. Helderman. *Archief*, 1921, 29, No. 21, 694-697.

At a certain carbonatation factory in Java, which, in addition to white grades, also turns out the after-product known as "centrifugalled sack sugar," some interesting experiments were conducted with the purpose of recovering the fine grain which is frequently found in the molasses, in order thus to realize a higher yield. The low grade massecuite was cooled in three sheet-iron tanks, each about the same capacity, No. 1 being open and unprotected, while Nos. 2 and 3 were lagged and covered, so that their contents took about twice as long to reach the factory temperature as that which had not been isolated. After standing about two months, the massecuites were separately cured, and the yield of the resulting sugar and the purity of the molasses ascertained, the figures obtained being as follows:—

TANK. No.	MASSECUIE.			MOLASSES.			SUGAR.	
	Brix.	Sucrose	Purity.	Brix.	Sucrose	Purity.	Sucrose.	Yield. ¹
1 ..	96.6 ..	38.58 ..	40.97 ..	85.5 ..	25.00 ..	29.24 ..	80.52 ..	45.69
2 ..	96.8 ..	41.36 ..	42.73 ..	84.0 ..	24.92 ..	29.67 ..	81.59 ..	62.24
3 ..	97.00 ..	41.24 ..	42.50 ..	84.2 ..	24.89 ..	29.56 ..	80.52 ..	56.10

Samples of the sugars were washed in a laboratory centrifugal with Pellet's liquor, and the grain examined for regularity and size, when it was seen that the crystals of the massecuites that had been cooled slowly were larger and better formed than those which had been treated in the manner customary in this factory. Another point is that no grain was found in the final molasses resulting from the massecuites which had been slowly cooled. Although the results obtained are not strictly comparable (the purity of the massecuites, for example, not being the same), the advantage of slow cooling is clearly indicated. It is hoped later to carry out more conclusive tests in this direction.

DETERMINATION OF SUCROSE BY THE DOUBLE POLARIZATION (CLERGE¹) METHOD, USING TANNIN AND LEAD ACETATE AS CLARIFYING AGENT. V. Sazavsky. *Listy cukrovarnické*, 1920-21, 237-245; *Zeitsch. Zuckerind. czechoslov. Republic*, 1921, 45, 32 and 33, 227-229, and 235-238.

In Frühling's book² the analyst is warned against the use of tannin for the clarification of solutions of sugar or molasses for polarization, on account of its optical activity; but Mr. SAZAVSKY in his interesting study states that he overcomes this objection by operating in the case of molasses in the following way: 100 c.c. of a normal weight solution contained in a 150 c.c. flask are treated first with 10-15 c.c. of a 6 per cent. solution of tannin, and then with 10-12 c.c. of lead acetate solution, following which the liquid is made up to the mark, mixed, filtered, and polarized. This proportion of lead acetate is sufficient to precipitate all the tannin, the addition of which latter reagent secures an enhanced clarifying effect. This method of clarification should be used not only for the liquid serving for the direct polarization, but also for the solution which is inverted. An error must surely result, it is pointed out, if a clarified solution be used for the direct polarization, and an unclarified one for the inversion polarization; and for two reasons: (1) because by clarification certain optically active substances are removed; and (2) because in the direct reading there is a concentration of volume due to the presence of the precipitate. Another matter of importance is that the divisor varies according to the concentration of the sugar. For concentrations of 3.25, 6.5 and 13 grms. of sugar per 100 c.c., the values stated by HERZFELD are 132.07, 132.22, and 132.66; while those now found by the author are 132.10, 132.32, and 132.74 respectively. It should be borne in mind that the presence of ash raises the value of these constants, as experiments with molasses ash (neutralized) here described demonstrate. As a matter of fact, it is more correct in the case of beet molasses containing about 10 per cent. of ash to use the divisor 132.66 for a concentration of 6.5 grms. than the theoretically correct one.

¹ Per 100 of sucrose originally present in the massecuite.

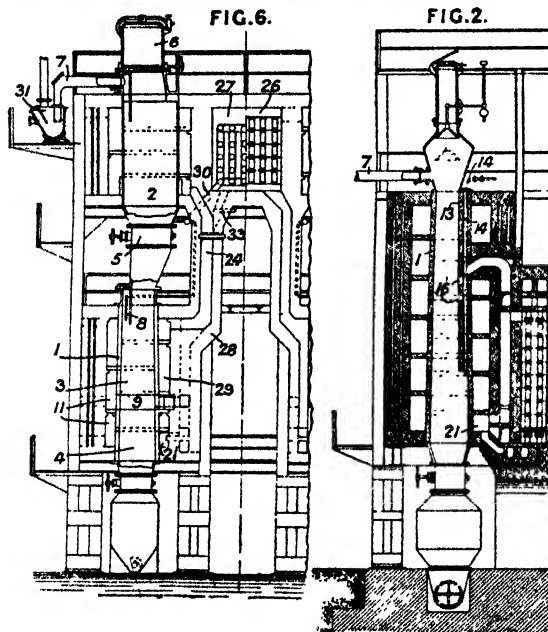
² "Anleitung zur Untersuchung der für die Zuckerindustrie in Betracht kommenden Materialien." 7th (1911) edition; page 128.

Review of Recent Patents.¹

UNITED KINGDOM.

CONTINUOUS MANUFACTURE OF DECOLORIZING CARBON. *J. N. A. Sauer, of Amsterdam, Holland.* 167,195 (14,771). June 11th, 1919.

Raw or partly carbonized carbonaceous material is passed through a retort or a series of associated retorts, and while therein, and without removal from the system, is subjected to zones of increasing temperature which may be classified generally as a preliminary distillation zone, a carbonizing zone, and a final zone of intense heating; and it is an essential condition that, in this final zone, endothermic reactions which would prevent the attainment of the requisite high temperature within the mass, are avoided, for example,



by ensuring that the carbonization is completed in the preceding zone, and that no gas or only inert gases such as chlorine or ammonia are introduced, and that any gases or vapours evolved or produced in the preceding zone are either deflected from the final zone or only enter therein after being rendered inert by passage through a sufficient height of material. If partly carbonized material is employed, the preliminary distillation may be carried out in a separate apparatus. When, however, raw carbonaceous material such as wood or peat is used, then it is a feature of the process that ammonia and other condensible products arising from destructive distillation can be recovered from the primary

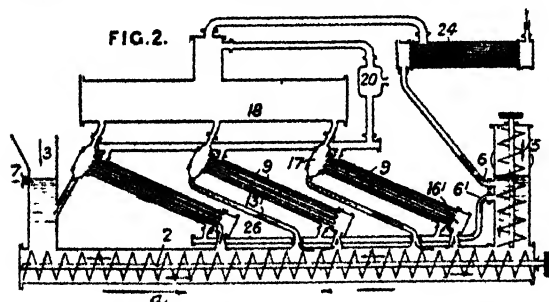
zone by reason of the separation of the several stages; and to facilitate the recovery of such products, gases such as carbon dioxide or steam may be introduced. Gases produced in the other zones may also be collected and utilized, for example, if combustible, for heating the retort or retorts. In the case of wood, peat, and the like raw material, the temperatures maintained in several zones are: primary distillation zone, 300–600°C.; carbonizing zone, 1200°C.; final-burning zone, 1500°C. Wood or other material to be carbonized may be used in its raw condition and in the dry or wet state, or it may first be treated with steam or water or with acid, alkalies, or solutions such as those of calcium, magnesium, or zinc chlorides, lime, or starch, which materials serve either as mineral spacing-agents or for the evolution of gases during carbonization, etc. Or these materials and others such as calcium carbonate and chloride of lime may be added in the dry state; and during the process there may be introduced air, steam, carbon dioxide or monoxide, hydrogen or chlorine. The finished product is cooled out of contact with the air, and is finally disintegrated in a ball mill.

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

The apparatus employed may consist of three vertical retorts, corresponding to the three zones mentioned above, superimposed and separated by valves or sluices; each retort is provided with inlets and outlets for gas or vapours, and is surrounded by a separate heating chamber, in the lowest of which the gases from the carbonization and final-heating zones are burnt, the hot gases being then passed through the upper chambers in succession so as to obtain the desired zones of increasing temperature as the material falls. On a single undivided retort or shaft 1, Fig. 2, may be used, in which case the combustion chamber 21 is arranged at the lower part of the shaft, and is supplied with gases withdrawn through apertures 16 at the side of the shaft and formed in a partition 13 extending for a part of or the entire height of the shaft; the gases and vapours evolved in the preliminary distillation zone are withdrawn through a branch 7; the perforations 16 may be covered by a slide (not shown), and the duct behind the partition accommodates a pipe 14 for the introduction of gas. Or the partition may be omitted, the gas being then introduced through a pipe passing through a tubular duct in the brickwork of the furnace, and the gases for heating the retort being withdrawn through pipes inserted at the intermediate and hottest zones. With such an arrangement the preliminary distillation may be carried out in a separate retort isolated by a sluice or valve. A plant is illustrated in Fig. 6, in which the preliminary distillation is carried out in an upper sheet-iron or steel retort 2 provided with a charging-hopper 6 and an outlet 7 leading to a main 31, and communicating by means of a slide 5 with a lower retort of fire-brick, etc., in which the carbonization and final heating are effected. The retort has an inlet 8 for superheated steam or gas, and an outlet 9 for retort gases, which are led to a combustion chamber 21 surrounding the lower end and hottest zone 4 of the retort; while the hot gases pass to a chamber 29 surrounding the carbonization zone 3, thence through a flue 24 to a chamber 11 surrounding the distillation retort or chamber 2, from there to a recuperator 26 for preheating the air for combustion, and finally to a superheater 27 for the steam. From the recuperator the air flows through ducts 28 and is further heated, and the steam, on its way to the inlet 8, is further superheated by passage through pipes 30. By means of a damper 33 part of the hot combustion gases may be passed direct to the recuperator 26.

EXTRACTION OF JUICE FROM THE BEET *Soc. Gen. d'Evaporation Procédés Prache et Bouillon*, of Paris. 144,721 (15,868). June 11th, 1920; convention date, April 7th, 1914; not yet accepted; abridged as open to inspection under Section 91 of the Act.

Beet slices are supplied to a hopper 3, fed by a screw 2 through a mixer *a* and is discharged by a screw 5 or other elevator; while water passes in counter-current from an

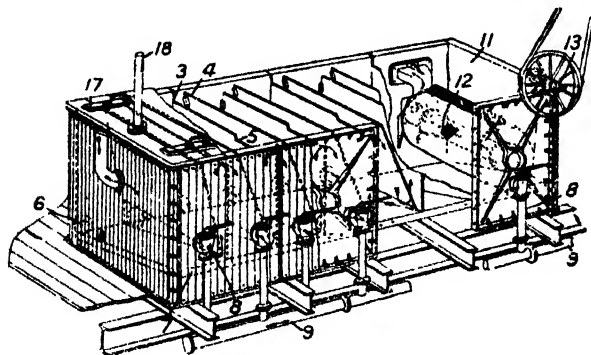


inlet 6 to outlet 7, part of the circulating liquid being removed at one or a number of points, concentrated by evaporation, and returned to the circuit at different points. The water condensed from the steam used for heating the evaporators is added to the circulating water. As illustrated in Fig. 2, liquid is drawn from the mixer *a* through

filtering-cloths 16¹, into the tubes of inclined heaters 9, in which the liquid boils. The boiling liquid is projected into boxes 17 from which the concentrated liquid is returned to the mixer *a* by pipes 13¹, and the steam passes to a chamber 18 from which part is withdrawn by a steam-jet ejector 20 and passed into the heaters 9 and the remainder passes through a heater 24 for preheating the water used for lixiviating. The condensed water from the heaters 9 is collected by a pipe 26 and is passed through an inlet 6¹ into the mixer.

APPARATUS FOR THE CLARIFICATION AND STRAINING OF CANE JUICES. *James Miller*, late of Derby. 166,037 (16,816). June 22nd, 1920.

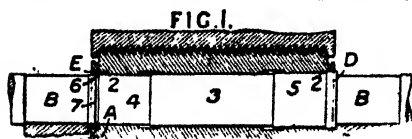
According to this invention cane juices are passed into a vat or settling tank having a plurality of weirs or baffles therein, and a submerged and preferably revolving strainer drum from the interior of which the clarified and strained juice is taken to an effect tank or other apparatus. In the figure is shown a tank divided into compartments by vertical plates 3, cut away at the top to form weirs 5. Each compartment is provided with an inclined baffle 4, an inclined bottom 7, sediment outlet 6, and an outlet 8 discharging to a main run-off pipe 9. In the last compartment 11 the liquid passes inward into a



closed drum 12 of wire gauze or the like, rotated from a driving-shaft 13. The spindle of the drum is slotted to allow the strained juice to pass to an outlet pipe leading to the effect tank or other apparatus. The tank is preferably lagged to prevent loss of heat and may be provided with detachable covers 17 and a vent pipe 18.

CANE CRUSHER. *L. W. Gould* (communicated by the *Fulton Iron Works Co.*, of St. Louis, Missouri, U.S.A.). 167,074 (21,439). July 16th, 1920.

In a crushing-roll having means to allow the roll to expand and contract relatively to its shaft, an intermediate portion of the roll is firmly secured to the shaft to prevent creepage of the roll on the shaft, while one or more end portions are movable relatively to the shaft to permit expansion or contraction. As shown, one end of the roll *A* is recessed to receive an abutment collar *D*, preferably formed integral with the shaft 13, and the other end is recessed to receive an abutment collar *E* removably secured to the shaft. Abutment shoulders 2 at the ends of the roll co-operate with the collars *D*, *E* and prevent or limit longitudinal creepage of the roll on the shaft.



The shaft, which is forced into the roll by hydraulic pressure, has an elongated intermediate portion 3 and end portions 4, 5, which are secured by firm frictional engagement with corresponding openings in the roll. The portion 3 is larger than the end portion 4 and smaller than the end portion 5, so that the shaft can be inserted into one end of the roll until its collar *D* reaches the roll. The portions 3, 4, 5 of the shaft are primarily larger in diameter than the corresponding external diameters of the roll, and the excess in diameter of the portion 3 is greater than the excess in diameter of the other portions 4, 5 so that the intermediate portion of the roll is firmly secured to the shaft while the comparatively free end portions of the roll permit longitudinal expansion and contraction. The removable collar *E* may consist of segmental sections 6 held in a groove 7 of the shaft by a ring 8 forced on to the shaft and into one end of the roll.

JUICE EXTRACTION BY ELECTRO-OSMOSIS. *Elektro-Osmose A.-G. (Graf Schwerin Ges., of Berlin, Germany)*. 146,453 (18,521). July 3rd, 1920. (One figure).

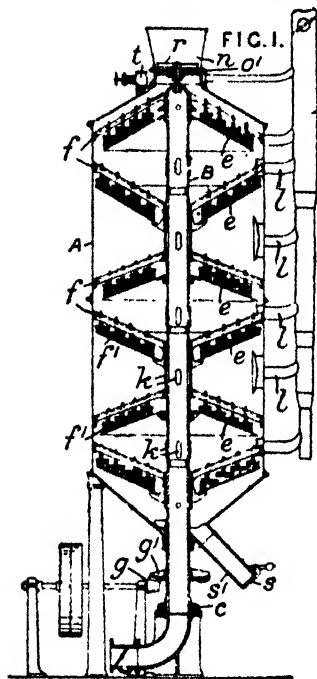
Beet slices and the like is subjected in the usual manner to a continuous or periodic extraction and at the same time to the purifying action of the electric current between diaphragms which are impervious to the solution obtained. The apparatus is advan-

Patents.

tageously of filter-press form, in that it comprises several frames for the reception of the material to be treated and of the impurities to be separated respectively, arranged like a battery with interposed permeable electrode surfaces and diaphragms, and provided with suitable admission and discharge ducts, the whole being combined into a single structure.

DRYING APPARATUS FOR SUGAR, ETC. *M. and W. Blake*, of Victoria Works, Greenock, N.B. 164,897 (9319). March 31st, 1920. (*Blake, Barclay & Co.*)

Apparatus for drying sugar or other granular material comprises in combination an outer casing *A* and a tubular shaft *B* to which is secured the alternately inverted and plain or louvered cones *e*, over the surfaces of which the sugar is traversed by the relative movement of the combs *f*¹ and the cones, the drying medium such as hot air being introduced into the casing through the adjustable apertures *k* formed in the shaft by a fan and exhausted therefrom through the baffled outlets *l* which communicate with an exhaust main *m*. As shown, the combs are adjustably attached to the arms *f* which are secured to the fixed casing, and the cones to the shaft which is mounted upon ball bearings *c* and rotated through the gearing *g*, *g*¹. The sugar is conveyed into the hopper *n*, within which it is shaved by a cutter *r* which is secured upon the shaft and then passed through an aperture *o*¹ into the casing, the opening of the aperture being controlled by a cover-plate which is adjusted through a worm and worm-wheel. The sugar may, however, be passed into the casing by a screw keyed upon the shaft, and is discharged therefrom through a tube *S*¹ which is closed by a weighted door *S* or alternatively by a screw mounted upon the lower end of the shaft. Steam may be admitted into the casing through a valve *t* so as to melt any sugar adhering to the interior of the apparatus. In modifications, the shaft may be fixed and the casing rotated, the comb-arms being secured to the shaft and the hot air may be passed into the casing through the exhaust main and exhausted therefrom through the shaft. The temperature and volume of the air passing into the casing may be varied by



fitting a fan with a variable speed upon the air-heating apparatus, which may be of the usual tubular type.

CASTING CHOCOLATE. *A. J. Stephens* (Communicated by the *Pennsylvania Chocolate Co.*, of Pittsburgh, U.S.A.) 166,296 (4123). February 10th, 1920.

A machine for making nut confection, particularly nut chocolate, comprises co-operating automatic means for intermittently depositing measured quantities of plastic confection, translating the deposits to another position, and intermittently depositing nuts thereon.

APPLICATION OF DECOLORIZING CARBON. *J. N. A. Sauer*, of Amsterdam. 166,229 (15,605). June 20th, 1919.

Decolorizing carbons such as those sold under the registered trade marks of "Eponit" and "Norit," containing at least 90 per cent. of carbon are boiled for a considerable time with excess of dilute acid such as hydrochloric acid and washed until the wash-water is neutral. The treated carbon, containing absorbed acid, is then used, in its wet condition to purify aqueous or alcoholic liquors such as sugar solutions which in the ordinary course would require acidification. The absorbed acid renders acidification of the liquid unnecessary. Specification 106,089 (of *R. von Ostrejko*) is referred to.

MANUFACTURE OF WHITE SUGAR FROM RAW. *D. Grant, of Litherland, Lancs*
159,640 (30,541). December 6th, 1919.

Raw sugar is mixed with dry kieselguhr or decolorizing carbon, which absorbs the impurities on the outside of the crystals and yields a dry sand-like substance. The mixture may be separated by mechanical means, as, for example, by washing in a centrifugal machine with a sugar solution to remove the absorptive substances, or the sugar may be dissolved in water, which may be acidified, when the absorptive substances retain the impurities.

CATTLE FOOD CONTAINING BAGASSE AND MOLASSES *H. S. Cox, of Georgetown, British Guiana.* 159,812 (34,759). December 9th, 1921.

A food for cattle, horses and other animals, is prepared from coco-nut residues, bagasse and molasses. The coco-nut flesh is reduced by means of a grater revolving in contact with the surface of water into which the coco-nut falls. The liquid is then strained off and the white residue pressed and dried by heat. The liquid after standing is boiled in metal vessels until the oil separates. The oil is strained, leaving a brown residue which is pressed and mixed with the white residue. Bagasse and hot molasses are then added.

EVAPORATION WITH THERMO-COMPRESSION. *Emil Josse.* 138,871 (3895). February 9th, 1921. (One figure.)

MANUFACTURE OF "ACTIVATED" (DECOLORIZING) CARBON. *E. R. Sutcliffe of Leigh, Lancs.* 166,202 (2595). February 1st, 1919.

An "activated" carbonaceous material adapted for absorbing gases is manufactured from coal in a finely divided condition by a process in which the powdered coal is first compressed into blocks,¹ and after the addition of previously activated material, then carbonized, and finally "activated" as by partial combustion in steam or air. The activation treatment is preferably carried out in vertical retorts, through which the material passes continuously; the gases to be passed through the retorts are heated in adjacent regenerators heated by combustion of the gases from the coking-plant or from the retorts.

Beet Crops of Europe.

(*Willott & Gray's Estimates to October 27th, 1921.*)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
Germany	Sept.-Jan...	1,330,000	1,152,960	739,548
Czecho-Slovakia	Sept.-Jan...	585,000	705,919	493,781
Hungary and Austria	Sept.-Jan...	100,000	90,000	12,151
France	Sept.-Jan...	285,000	205,041	154,444
Belgium	Sept.-Jan...	280,000	242,569	146,918
Holland	Sept.-Jan...	335,000	316,402	238,692
Russia (Ukraine, Poland, etc.)	Sept.-Jan...	325,000	255,354	226,691
Sweden	Sept.-Jan...	165,000	164,194	145,072
Denmark	Sept.-Jan...	120,000	134,835	152,852
Italy	Sept.-Jan...	200,000	135,484	182,843
Spain	Sept.-Jan...	135,000	200,000	81,660
Switzerland	Sept.-Jan...	5,500	3,710	8,550
Bulgaria	Sept.-Jan...	22,000	7,837	10,974
Rumania	Sept.-Jan...	25,000	5,000	....
		3,912,500	3,719,325	2,594,166

¹ For example, as described in U.K. Patent, 20,679 of 1914.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to October 27th, 1921.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
United States—Louisiana	Oct.-Jan. ..	200,000	180,996	108,035
Texas	" " ..	1,000	6,238	None
Porto Rico	Jan.-June ..	415,000	437,336	433,825
Hawaiian Islands	Nov.-July ..	450,000	508,392	496,183
West Indies—Virgin Islands	Jan.-June ..	5,000	4,500	12,400
Cuba	Dec.-June ..	3,000,000	3,900,000	3,730,077
British West Indies—Trinidad	Jan.-June ..	52,000	54,933	58,416
Barbados	" " ..	30,000	30,000	54,279
Jamaica	" " ..	35,000	40,000	46,875
Antigua	Feb.-July ..	10,500	11,320	15,540
St. Kitts	Feb.-Aug. ..	8,000	8,000	10,036
Other British West Indies	Jan.-June ..	10,000	10,000	5,651
French West Indies—Martinique	Jan.-July ..	20,000	25,000	19,097
Guadeloupe	" " ..	20,000	25,000	25,500
San Domingo	Jan.-June ..	250,000	185,546	176,736
Haiti	Dec.-June ..	3,000	5,625	4,125
Mexico	" " ..	110,000	115,000	92,000
Central America—Guatemala	Jan.-June ..	19,000	17,500	15,100
Other Central America	" " ..	18,000	20,000	20,000
South America—				
Demerara	Oct.-Dec. and May-June ..	95,000	100,000	96,000
Surinam	Oct. Jan. ..	10,000	12,000	12,000
Venezuela, exports	Oct.-June ..	16,000	15,000	18,000
Ecuador	Oct.-Feb. ..	7,000	6,998	7,628
Peru	Jan.-Dec. ..	325,000	350,000	330,000
Argentina	May-Nov. ..	175,000	201,998	298,709
Brazil	Oct.-Feb. ..	250,000	300,000	177,155
Total in America		6,534,500	6,541,382	6,262,367
Asia—Brit. India (consumed locally)	Dec.-May ..	2,200,000	2,349,000	3,049,157
Java (1922—1,550,000)	May-Nov ..	1,550,000	1,508,755	1,335,763
Formosa and Japan	Nov.-June ..	425,000	342,176	283,482
Philippine Islands, exports	" " ..	250,000	289,000	209,336
Total in Asia		4,425,000	4,488,931	4,877,738
Australia (1921-22—270,000)	June-Nov. ..	270,000	175,000	162,288
Fiji Islands	" " ..	50,000	60,000	60,000
Total in Australia and Polynesia		320,000	235,000	222,298
Africa—Egypt (consumed locally)	Jan.-June ..	75,000	79,706	86,712
Mauritius	Aug.-Jan. ..	200,000	254,810	235,490
Réunion	" " ..	35,000	40,000	32,336
Natal	May-Oct. ..	150,000	140,000	142,851
Mozambique	" " ..	40,000	45,000	38,746
Total in Africa		500,000	559,516	536,135
Europe—Spain	Dec.-June ..	5,000	6,886	6,048
Total cane sugar crops		10,784,500	11,831,715	11,904,586
Europe—Beet sugar crops		3,912,500	3,719,325	2,594,166
United States—Beet sugar crop	July-Jan. ..	900,000	969,419	652,967
Canada—Beet sugar crop	Oct.-Dec. ..	23,000	34,600	16,500
Total beet sugar crops		4,835,500	4,723,344	3,263,623
Grand total Cane and Beet Sugar	Tons..	15,620,000	16,555,059	15,168,209
Estimated decrease in the world's production ..	" " ..	935,059	....	....

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING OCTOBER 31ST.		TEN MONTHS ENDING OCTOBER 31ST.	
	1920. Tons.	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS.				
Germany .....	....	....	5,831	....
Netherlands .....	....	....	....	595
Belgium .....	....	301	....	301
France .....	....	..	....	....
Czecho-Slovakia .....	..	....	....	....
Java	66,489	660	162,766	24,971
Philippine Islands .....	....	....	....	....
Cuba	34	13,429	516,476	218,052
Dutch Guiana .....	....	....	58	1,248
Hayti and San Domingo ..	....	48	13	88
Mexico .....	....	....	....	....
Peru	3,399	799	35,785	68,150
Brazil	4	4,001	6,038	54,623
Mauritius	3,684	2,251	101,819	182,244
British India	658	....	16,271	1,466
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	715	7,268	122,253	97,404
Other Countries	5,578	4,760	33,604	42,734
Total Raw Sugars.....	80,560	33,508	1,000,914	689,878
REFINED SUGARS.				
Germany .....	....	....	126	1
Netherlands	1	5,379	1,064	79,307
Belgium	1	3,872	2,056	19,990
France .....	....	....	293	2,631
Czecho-Slovakia .....	....	....	102	138
Java	1	1,549	5,011	3,240
United States of America ..	28	7,611	102,243	169,438
Argentine Republic.....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	74	4,767	8,723	128,949
Total Refined Sugars ..	105	23,178	119,619	403,695
Molasses	8,268	9,944	66,101	76,744
Total Imports.....	88,933	66,680	1,186,634	1,170,317

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .....	....	....	....	1
Netherlands	108	64	110	1,778
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	157	112	790	1,197
Canada .....	....	....	....	....
Other Countries	181	279	233	2,444
	446	455	1,134	5,420
FOREIGN & COLONIAL SUGARS.				
Refined and Candy.....	50	36	2,850	366
Unrefined	1,688	363	9,606	2,629
Various Mixed in Bond....	....	....	....	....
Molasses	452	62	3,218	517
Total Exports.....	2,636	916	16,808	8,933

Weights calculated to the nearest ton.

United States.

(Willott & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920. Tons.
Total Receipts January 1st to October 27th ..		2,178,357 ..	2,635,879
Deliveries		2,189,409 ..	2,624,256
Meltings by Refiners		2,157,844 ..	2,360,007
Exports of Refined		335,000 ..	325,000
Importers' Stocks, October 27th	11,623
Total Stocks, October 27th		61,072 ..	71,311
		1920.	1919.
Total Consumption for twelve months		4,084,672 ..	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

	(Tons of 2,240 lbs.)	1918-19. Tons.	1919-20. Tons.	1920-21. Tons.
Exports		3,135,399 ..	3,209,884 ..	2,036,417
Stocks		590,606 ..	311,063 ..	1,187,555
		3,726,005	3,520,947	3,223,722
Local Consumption		74,000 ..	70,700 ..	95,000
Receipts at Ports to September 30th		<u>3,800,005</u>	<u>3,591,647</u>	<u>3,318,972</u>

Havana, September 30th, 1921.

J. GUMA.- L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TEN MONTHS ENDING OCTOBER 31st, 1913, 1920, AND 1921.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	716,828	119,619	403,695	702	2,850	366
Raw	841,408	1,000,914	689,878	3,464	9,606	2,629
Molasses	123,438	68,101	76,744	276	3,218	517
	<u>1,686,674</u>	<u>1,188,634</u>	<u>1,170,317</u>	<u>4,442</u>	<u>15,674</u>	<u>3,512</u>
				HOME CONSUMPTION.		
				1913. Tons.	1920. Tons.	1921. Tons.
Refined				711,286	140,497	390,142
Refined (in Bond) in the United Kingdom				609,976	682,898	657,725
Raw				99,244	160,621	108,537
Molasses				26,499	24,824	9,537
Molasses, manufactured (in Bond) in United Kingdom ..				30,715	60,763	33,199
Total				<u>1,477,720</u>	<u>1,068,603</u>	<u>1,204,140</u>
Less Exports of British Refined					1,134	5,420
				<u>1,457,740</u>	<u>1,068,469</u>	<u>1,198,720</u>

Sugar Market Report.

Our last report was dated 11th October, 1921.

The outstanding feature to record is a revival of confidence in the home markets which has led to more active conditions than have been seen for some time past. Continued depression resulted in a further general decline in values, but towards the end of the month the pressure to sell American granulated on this side became decidedly less, and it began to be realised that there was no superabundance of white sugar for this market. Prices had come down substantially and the actual bareness of trade stocks helped the demand and inspired the confidence to buy. It is true that nearest available sugars were most in request, but some quantities were taken for delivery up to the end of the year. A considerable business was done in Czecho-Slovak superior sugars, and to-day SCH Fine, TTDA and similar qualities of granulated are quoted at 20s. 3d. prompt, 20s. November, 19s. 9d. December f.o.b. Tate's London granulated 49s. 9d., No. 1 Cubes 55s. 6d. per cwt. spot duty paid. Belgian crystals FW, etc., 19s. 6d. f.o.b. November/December. American granulated on the spot is held for 49s. and second-hand lots c.i.f. are quoted 21s. 6d. White Javas Spot 47s., Cuban 96° centrifugal sellers at 14s. 9d., Brazil and Peru 96° 14s. 6d. Brazil 80° 10s. c.i.f. U.K. In W.I. crystallized on the spot a fair demand has been met for cheaper qualities ranging in value from 38s. to 40s. and these are now practically sold out, but better kinds up to 42s. are selling rather slowly. Good Muscovados value about 35s. spot, duty paid.

In connexion with the satisfactory U.K. consumption shown by the Board of Trade figures for the ten months to October of the present year, it is interesting to note that the distribution of sugar by the Royal Commission on the Sugar Supply amounted to 1,595,004 tons in 1919 and 952,408 tons in 1920. These figures do not include privately imported sugar sold during those years for manufacturing purposes other than Syrup and Invert making. It is not unreasonable to anticipate further expansion in the consumption, considering that a more moderate range of prices has already been reached, that the restrictions upon supply are now removed and that the country is looking forward to an improvement rather than otherwise in economic conditions.

In the U.S. greater activity in consumption has been observable during the past three weeks, due to conditions very similar to those ruling here; the fear of a strike drew attention to the scarcity of the stocks inland, and the shortage of raws in the hands of refiners.

The Cuban Selling Committee by reducing the price to 2½c. c. & f. New York were enabled to place considerable quantities to the U.S. refiners and further sales reported include some 30,000 tons to U.K. refiners at 14s. 9d. per cwt. c.i.f. and 6,000 tons to France at 15s. 6d. c.i.f. prompt shipment.

Total receipts in Cuba to 5th November, 1921, are given as 3,264,000 tons against 3,542,439 tons in 1920 and 3,892,639 tons in 1919. Messrs. WILLETT & GRAY whilst giving 3,000,000 tons as their estimate for the next Cuban crop, explain that this must only be taken as a tentative figure, in view of the many uncertain factors affecting conditions in the Island.

From Mauritius it is reported that 7000 tons crystals were sold at 18s. 1½d. f.o.b., and latest cables state that 2000 tons have been done at the equivalent of 17s. 9d. f.o.b.

Shipments of White Javas to India during October were again very large, although the figures are not yet to hand. It appears that stocks in the Indian ports are accumulating too rapidly, and many lots are being offered for resale below the Java parity, particularly from Calcutta and Karachi. Meantime, holders in Java seem incline to maintain asking prices at about 12½ guilders for Whites and 9½ to 9¾ guilders for Browns f.o.b. Japan has been a free buyer of Muscovados, the demand for which has forced the price up to 11½ guilders f.o.b. The sterling quotation for Whites, first hand, may be called about 19s. December/January and January/March c. & f. Calcutta, resellers probably 1s. per cwt. less.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3.


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Notes and Comments.

The Indian Sugar Committee and Coimbatore.

Elsewhere we conclude our somewhat lengthy review of the Report of the Indian Sugar Committee; we have devoted, the last few months, a considerable amount of space to summarizing and discussing the conclusions come to by this Committee, because we believe that the sugar world at large is interested in studying the evidence of what has been the most thorough investigation of Indian sugar production practice ever undertaken. Hitherto the production of sugar in India has had comparatively little effect on the world's sugar market, because India has never been in our days an exporting country, while its imports have seldom been on the large side and have depended more on the existence of a cheap surplus of foreign sugar than on any standard demand. The Indian market has been a peculiar one, almost exclusively supplied by the local production of a low grade type of sugar extracted from canes that would not satisfy requirements in other cane growing countries. The work of the Committee was to ascertain whether Indian practice could be brought up more nearly to the world standard of scientific production in the light of existing native prejudices, customs, and drawbacks. There are a good many "ifs" in the conclusions come to by the investigators concerned, but on the whole it is considered that the attempt is worth making, though the rate of progress does not promise to be rapid, and much patient and painstaking spadework will need to be done before any appreciable improvement is recorded, and in particular before India can claim to rank as an exporting country of high-class sugar.

But since one recommendation of the Committee is the establishment of a great Research Station for carrying out the scientific work indispensable for a modern industry, one would have thought that they would have viewed the work of what is a scientific station of world-wide interest—Coimbatore—in a more favourable light than is actually the case. But when we read for ourselves their report on the work of this station, it is hard to avoid the conclusion that an excessive amount of criticism has been directed to minor points and to matters of mainly academic interest, and too little has been devoted to recognising the solid worth of the work actually accomplished during the last ten years on this noted Indian cane breeding

station. Moreover, some of the points of criticism raised seem to us to be based too much on magnifying a desirable ideal of the station into a leading practice and then deprecating it. The Committee direct their "most material criticism" to the policy of the Coimbatore officials in endeavouring to discover new (and we presume super-hardy) varieties, the opinion of the Committee being in effect (as we understand it) that these officials are only pursuing a chimera since the varieties to be distributed should have preferential treatment from the ryots (which on the Committee's own showing is probably the last thing they will get). But in view of the fact that the policy of Coimbatore as laid down in 1912 was to produce new seedlings for further testing by local stations in other parts of India, which stations would in their good time supply the cultivator as they deemed best, we hardly think it fair to raise the point first when discussing Coimbatore. It appears to us to affect more closely the policy of the local stations. Moreover, is the work of research at the cane breeding station to be restricted to supplying only canes that will depend for their success on problematical improvements in native cultivation and not include any research whatever for varieties that would thrive even under the ryots' present standard of treatment? Time alone can show whether the Station's ideal is a chimera or not, but we fail to see why the Committee should wish to restrict the range of experimentation undertaken by Coimbatore, especially as there is no indication (judged by past progress) that Indian cultivation will in the future improve with any rapidity.

Then, finally, are not the Committee treading on somewhat debatable ground in criticising the details of the selection of seedlings at Coimbatore? They imply for instance that the seedlings were kept there too long before being sent away for further trial, but we prefer to believe that the scientific staff at the Station would know best when a given lot of seedlings could be released for further trial, and they would hardly desire to detain them unnecessarily long. On the other hand, has not Coimbatore the right to ensure that the seedlings she sends out are sufficiently tested to stand a chance of being successful? If they fail, the discredit falls mainly on Coimbatore. Had the Committee included on its body a botanist or mycologist, this criticism would necessarily have had due weight; but, as we gather it did not, we can only characterize as unfortunate this incursion into the domains of the scientific officer.

We have criticised rather freely this section of the Indian Committee's report because, compared with the somewhat lavish praise they bestow on the work for example at Manjri Farm, they are singularly chary of appreciation of the much more scientific work that has been accomplished at Coimbatore; it is not on these lines in our view that the question of establishing a great Research Station should be approached, and we can only hope that if the latter ever comes to be created by the Indian Government, more adequate credit will be accorded to the policy and the work of Coimbatore. In the meantime, we feel bound to protest in the interests of scientific sugar cultivation at the very indifferent recognition the Indian Sugar Committee have accorded the work at Coimbatore, both under its late head, Dr. C. A. BARBER, C.I.E., and more recently under the charge of RAO SAHIB T. S. VENKATARAMAN. It is true that they wind up with a brief acknowledgment of "the great benefit to India of the work done by Dr. BARBER," but as the bulk of their chapter on Coimbatore is one of criticism, the readers of the Report might be pardoned for thinking that the net result of the investigation is on the whole unfavourable to the work of the Station in the past.

American Interests in Cuba.

Up to the time of the enactment of the Fordney Tariff in the United States, the import duty on Cuban sugars entering that country was 1 cent. per lb. It was then raised to 1·6 cents, which, at recent prices, represents an *ad valorem* duty of some 80 per cent. Free trade economists in the United Kingdom are fond of declaring that if we put on a tariff against foreign goods, the consumer is bound to pay the tax himself in the price he is ultimately charged for the goods. Theoretically, it would be more reasonable to assume that his liability in that respect would be no more than the taxed proportion of the total amount of such goods he absorbs. In other words, if 40 per cent. of these goods come under the tariff and the rest are free, the addition to the price should not exceed 40 per cent. and might from other causes be less. But in the case of Cuban sugar entering the United States, although it amounts to some 50 per cent. of the total American consumption, yet in practice Cuba, not the American consumer, has been paying the tariff duty, with the result that while the American consumer has benefited, the American domestic producer of sugar has stood to gain no increased return on his duty-free product. Competition has kept the price down, as might have been expected to prove the case; at the same time, the American domestic producer still has an advantage over the Cuban competitor in that the latter has had to accept a lower price by practically the amount of the duty. So far so good for the consumer.

But there is the producer's side to consider, and it is complicated by the fact that American business men have themselves a very large holding in Cuban industrial properties. How big is shown in a letter addressed by one of them to *Facts about Sugar*. This writer declares that the American interests in Cuba amount to over six billion dollars in value, or quite six times as much as is invested in the American domestic beet sugar industry. Yet owing to the incidence of the high Fordney tariff, these interests in Cuba have to pay their share of the duty (which at present all comes out of the Cuban pocket—a total sum said to amount to \$32,000,000 per annum). This share they do not fancy paying indefinitely, and in consequence a strong committee has been formed to make representations to the American Congress that the increased tariff seriously cripples the American industry of sugar production in Cuba, without in any way actually benefiting the indigenous beet sugar industry. They further point out that in herself having to pay the large sum represented by the duty, the ability of Cuba to buy the goods of American manufacturers and merchants is seriously impaired. So long as Cuba takes 5 cents per lb. to produce her sugar (as was the average cost last crop), but has to sell to the States at a little over 2 cents per lb. *in Cuba*, the inducement to go on producing is not very apparent, nor is it evident how she is to accumulate the funds to purchase goods from the States. No wonder, then, the petition to Congress is being signed freely by nearly all the American engineering firms interested in making sugar and plantation machinery for Cuban estates. Congress will be requested at the least to reduce the tariff to the old rate of 1 cent per lb., at which figure the domestic sugar industry was able to prosper in the past.

The fixing of the American tariff is primarily a matter for the Americans themselves; but it is a welcome sign that, as in the present instance, American industrialists are beginning to realize that a high tariff is not invariably an advantage for their country. The majority opinion of the countries of the world is overwhelmingly in favour of a tariff system, but between a scientifically conceived tariff of moderate dimensions and a crushingly high tariff there may be a

wide gulf into which the tariff imposers may conceivably themselves fall. There is an unprecedented tendency nowadays for the Anglo-Saxon nations and others to work for a rapprochement; nothing will contribute more to achieve that end than a give-and-take spirit in commercial matters; for, after all, the average individual is more concerned with his commercial pursuits and their effect on his domestic life than on any national aggrandizement. At present we have the strange spectacle of America being the richest country in the world as measured by the world value of her dollars, and yet being unable to undertake anything like a competitive business deal with the rest of the world, because the latter cannot afford to pay or can only do so by offering goods which the American tariff prevents the American from accepting. It will be interesting for economists to watch whether the United States can restore and stabilize its international trade without modifying in any respects its tariff system.

The Cuban Crops

Mr. HIMELY gives the total of the past Cuban crop as 3,935,433 long tons. This amount falls short of his original estimate of 4,051,000 tons by only 2.85 per cent. The deficiency is very moderate considering the difficulties, financial and otherwise, that have marked the year in question in Cuba. Three new mills that were to have ground during this crop were unable to do so. And the unusual rains which forced a late commencement of the crop and caused the yield of sugar to be low were another factor contributing to a lower production.

The coming crop is expected to be over 3,000,000 tons. In view of the large surplus from the old one still in hand, the market is dubious as to the wisdom of letting the new crop be reaped freely, and there has been some talk of issuing a Presidential Decree imposing a tax on all sugar made before February which would have the effect of shortening the crop. But nothing seems to have been done and meanwhile grinding has been commenced. Our Continental Correspondent indicates on another page that the deficit, based on the consumption, in the European beet industry is no less than 2,000,000 metric tons. But one doubts whether those countries where the deficiency is marked can afford to purchase much foreign sugar with the exchanges what they are. Otherwise, it would seem a simple solution to dispose of the Cuban surplus by sending it to Europe.

Frost-Resistant Cane.

We publish on another page of this issue an interesting series of figures prepared by Dr. W. E. Cross, the Director of the Tucuman Sugar Experimental Station, showing the great resistance to frost of certain Java seedlings when compared with the local varieties grown in Argentina in past years. These seedlings, no longer of importance in Java, have been successfully introduced to many sugar cane countries lying on or near the limits of the tropics, in some of which occasional frosts occur; and it is interesting to note that their male parent, *Chunnee*, belongs to a frost-resistant alliance in north India. The character of frost resistance thus appears to be hereditary, and we are somewhat surprised that more efforts have not been made to obtain other seedlings sharing the same character. We note that in the Cane-breeding Station at Coimbatore the attempt is made to differentiate the seedlings raised for different parts of India, and that frost-resistant cane varieties are aimed at for the Punjab, where frosts occur every year, and yet over 400,000 acres of cane are grown. *Chunnee* and its allies having certain objectionable characters, such as the liability to smut, other frost-resistant parents have been called into requisition; thus, a notable success has been obtained in using the wild grass *Saccharum spontaneum* as a male parent,

Notes and Comments.

with thick tropical canes as mothers. This wild grass is somewhat closely allied to the *Chunnee* variety, but is more hardy, and the seedlings thus obtained and now being tested in the Punjab are some of them reported to be very promising. Those who are interested in this question should refer to a bulletin¹ prepared by the late Mr. J. H. BARNES, of the Indian Agricultural Service, on the characters of the canes in the Punjab. Among many other matters he treats of the relative frost resistance of the common varieties grown; and as the result of two years' observations and analyses, he divides the indigenous canes of the tract into four classes as to the effect of the annual frost upon their growth and the purity of their juice. He places the relatives of *Chunnee* in the first and second classes, they having shown themselves unaffected or quickly recovering if injured. But this is not all. Two members of the Pansahi class are included, which differ widely in their resistance, namely, *Merthi*, which in both years was placed in the first class, and *Kahu*, a more recent introduction, which is only found in the fourth class, which includes non-resistant canes. As *Uba* or *Kavangire* also belongs to this class, and is hardly frost-resistant, we think that it would be worth while to pay some attention to *Merthi* and try and obtain seedlings from it (as one parent) in order to have a second string to *Uba*, superior to it in at least one particular. We would accordingly invite Dr. Cross's attention to these remarks if he has not already given them consideration.

China's Awakening.

Many observers are of the opinion that in reckoning up the future possibilities of the world's sugar consumption, the vast territory known as China, with its immense population, will in the end prove a very big asset in setting the demand. Whether China remains an importer of foreign manufactured sugar, or sets about making her own from home grown cane and beet, the result cannot fail to be a great access of trade, either in sugar or in sugar machinery and appliances. Time is of course needed to achieve the expansion one hopes for; but the thing for the moment appears to be that China is at last abandoning her traditional dislike of foreigners and foreign goods, and is taking more readily to international trade. The present position is well summed up in an extract which we give below from a General Report on the Commercial, Industrial, and Economic Situation in China last June, prepared by H.M. Legation at Peking (and issued by the Department of Overseas Trade: 1s. 9d. net).

"It is difficult to write about a country like China with a due sense of proportion, to bear in mind that China with a total area of over two million square miles and a population of nearly four hundred millions is really not one country but rather a continent or group of countries, differing one from the other as regards climate, natural resources, language and economic conditions. For instance, a terrible famine in the north spread over an area six times the size of Great Britain, and affecting over 30,000,000 people, did not prevent a record export of wheat and flour to foreign countries last year; a series of typhoons of appalling violence which devastated the crops in one part of a province had apparently no effect on the business done at a treaty port in the same province, which is described in the Customs reports as having been 'on the whole profitable.' Machinery and materials for China's growing industries were imported in steadily increasing quantities in spite of civil war and organized brigandage which for months at a time interrupted transport on the country's principal trade routes,

¹ Sugar and the Sugar Cane in the Gurdaspur District. J. H. BARNES. Bull. No. 69, Agricultural Research Institute, Pusa, 1918, pp. 55 to 61.

such as the upper waters of the Yangtze and West Rivers, and the virtual extinction of China's historic tea trade with foreign countries is counterbalanced by the steady growth in the export of minerals, coal, cereals, and tobacco. These considerations go some way towards explaining the apparent anomaly of a record trade in a year marked by every kind of political, commercial and natural disaster, and point to the wonderful vitality of China's trade, which confirms one in the belief that China is at the present time, with the possible exception of South America, one of the greatest undeveloped markets in the world, and is destined in the fulness of time to take a place among the great industrial nations of Europe and America.

"A recent tour of the northern provinces served to strengthen the opinion held for some time past that China, in spite of internal dissensions and misgovernment, in spite of lack of communications and neglect of the scientific development of her vast natural resources, is making slow but real progress, and that she is on the eve of a period of unexampled commercial and industrial development which will in a few years' time bring about a complete change in her economic situation. The potential wealth of the continent is enormous: China is producing in steadily increasing quantities almost every kind of raw material, animal, vegetable and mineral, known to the world's industries; she is beginning to utilize these materials by manufacturing for herself what she has in the past been obliged to import from abroad. The standard of living all over the country is rising slowly among the mass of the people, very quickly among the educated monied classes. The Chinese have overcome to a large extent their traditional dislike and suspicion of foreigners and foreign ways, and are rapidly assimilating Western customs and Western modes of living. Foreign style goods are ceasing to be luxuries and becoming necessities, and the writer still believes that this tendency is to our advantage, and that we shall see that the Chinese, while relying more and more on their own industries to supply the wants that intercourse with foreign nations has created, will purchase far more freely than they have done in the past the better class of goods that they cannot produce at home. And in the process of this industrial development there will be a demand for every description of foreign machinery and mechanical appliances which should keep British manufacturers busy for many years to come."

Beet Sugar Factories in Belgium.

Most of the sugar factories in Belgium (states an American Consular Report) are limited liability companies, and therefore stockholders are unknown. As a rule the small sugar factories were constructed in the beginning with the co-operation of land-owners and beet sugar growers. It sometimes happens that these limited liability companies give shares of stock to growers, whether individually or grouped in associations. Consequently the limited companies reserve for the account of the beet sugar producers a part of the shares representing the capital stock of the companies.

The total number of sugar factories in Belgium is 58. There are five refineries. No sugar factories or refineries belong to the State, nor are they managed or placed under its control. The smallest factory handles about 200 metric tons of beets in 24 hours; the largest may reach 4000 tons. The growers make contracts with the sugar factories generally in February or March; that is to say, before planting. The general conditions of the contracts include the sowed area, the delivery of beets, the price, the return of the pulp or molasses, and the duration of the agreement. In general, the grower agrees to send his crop to the factory totally or partially. A specific weight of beet is seldom mentioned in the contract.

Fifty Years Ago.

From the "Sugar Cane," December, 1871.

In this issue of our predecessor there appeared a note by RAOULT on the "Transformation of a Solution of Cane Sugar into Glucose by the Influence of Light," which had originally been communicated by him to the Académie des Sciences, Paris.¹ Two white glass tubes had been filled with a 20 per cent. solution of white sugar, boiled for some minutes, and hermetically sealed before any air could obtain access. One tube was kept in a very light place, and the other in the dark. At the end of 5 months, it was found on opening the two tubes, and examining their contents, that whereas the solution in the tube which had been kept in the dark had no effect on Barreswill's solution, the other gave an abundant red precipitate. It was concluded from this and other experiments that inversion had occurred under the influence of light.

However, it may be noted that this conclusion was not accepted by later investigators. PELLET,² for example, controverted it, and so did GLADSTONE and TRIBE³; while BÉCHAMP⁴ pointed out a few years after that sugar solutions containing certain micro-organisms may be kept in the dark for several months without decomposition, though inversion rapidly sets in when they are exposed to light.

An article was reproduced in this issue from the *Commercial Gazette* of Mauritius, in which it was pointed out that the 1870-71 crop had been the smallest for the last 18 years, namely 89,000 metric tons; but this did not discourage the planters and manufacturers of that Colony, whose spirit of enterprise and perseverance is shown by the following quotation: "We must examine and compare the past, and use our intelligence to look as far as we can into the future. . . . Greater exertions will be required to maintain our production. Not only as regards mere manual labour, but as regards skill, science, and economy. We are justified in expecting these will be forthcoming when we look at the improvements and the successful efforts made here to overcome difficulties as they arise. We estimate that by the improvement in our manufacture, on the aggregate the sugar produced is worth a dollar per cwt. more than it was 10 years ago. . . . Economy of manufacture is also pushed to a great perfection on some estates to be imitated by others a little later. Twenty per cent. of the juice is no longer left in the cane, thanks to the additional pressure of the trash as it comes from the mill. If only a small portion of the immense quantity of water which flows into the sea could be reserved for the irrigation of plantations when they need it, and if by the plantation of trees our climate could be favourably influenced and our sources and rivers preserved, our production may not only be well kept up but increased, and the vicissitudes of agriculture by drought considerably diminished. . . ."

Two patents were noticed in this issue. In the first by L. WEINRICH and J. SCHRÖDER,⁵ the boiled juice was cast into shapes adapted to be arranged in rings in the centrifugal machine, these shapes being washed into white sugar by admitting steam mixed with air. In the second by M. M. HARRIS,⁶ an apparatus was described for distilling liquors containing alcohol *in vacuo*, comprising a pan with goose-neck arrangements and a glass tube communicating with a vacuum receiver with concavo-convex corrugated plates or shelves and a secondary vacuum receiver.

¹ *J. Fabr. Sucre*, 12, 11. ² *Ibid.*, 19, 5. ³ *J. Chem. Soc.*, 1883, 43, 341-343.

⁴ *Bull. Soc. Chém.*, 9, 21. ⁵ English Patent, 1185 of 1871. ⁶ English Patent, 1048 of 1871.

The Report of the Indian Sugar Committee.

III.—MANUFACTURE AND ORGANIZATION.

From the previous article of this series¹, in which Part I of the Report (Agricultural) was dealt with, it was seen that the problem of extending and improving the Indian Sugar Industry, on its agricultural side, is one of great complexity. The different provinces were passed under review and the Committee's findings enumerated regarding the possibilities in each, with the result that it was considered that any material improvement along these lines would be extremely slow at the best. Part II of the Report deals with the manufacture of gur and white sugar and is rather disheartening reading, for its perusal leads us to the conclusion that the problem is, if anything, more complex than the agricultural, and calls for vast expenditure on the part of the Government before any tangible results are likely to be obtained. Part III lastly, after chapters on the Tariff Question and Statistical Returns, unfolds the scheme of organization which the Committee proposes. The chief points of this scheme are the formation of a Sugar Board, the erection of a pioneer factory to deal with 1000 tons of cane a day, the founding of an up-to-date Research Institute with sub-stations all over India, the erection of a Sugar School with small model factory in connexion with the Institute, and the continuance of the Sugar Bureau and Cane-breeding Station until their absorption by the Research Institute.

The first chapter in Part II deals with the problems with which the Committee are faced on the manufacturing side, the main thesis being the losses at present incurred. Gur making is essentially a cottage industry and dominates the situation, taking up 99 per cent. of the supplies of cane available for crushing as against 1 per cent. used for making white sugar. There are according to the Committee's estimate 31.6 millions of tons of cane grown in India, of which it considers that 5.4 millions are not used for gur but for other purposes, such as chewing and making white sugar. This leaves 26.2 million tons which, at 9 per cent. gur on cane give 2,358,000 tons of gur. The sucrose in the cane is taken as 12 per cent., which gives 3,114,000 tons sucrose in the canes used: the sucrose in the gur is estimated at 1,647,456 tons as against a possible recovery of 2,716,416 tons: hence the loss in sucrose in gur making in India works out as 1,068,960 tons.

There are 18 factories at work making white sugar, but the total output is less than in one large factory in Java, Cuba or Hawaii: these Indian factories recover 57.14 per cent. of the sucrose in the canes milled, as against 86.4 per cent. in modern factories in those countries, where however it must be remembered that thicker and less fibrous canes are used. For the improvement of these defects the Committee discusses eight possible courses. Of these the main lines selected are the improvement of gur manufacture on a small scale and the improvement and enlargement of the class of sugar factories. The Committee rejects the following lines:—the improvement and extension of making white sugar from *rab*, the manufacture of sugar in small factories with open pans and grinding 1-2 tons of cane per hour, and the manufacture of sugar from gur in large factories. Three more lines are regarded as of limited value, but the Committee suggests that they should be further investigated:—the manufacture of gur in large factories, and the manufacture of muscovado and other intermediate products on a small scale and in large factories. An interesting description is given of the indigenous process of making sugar from *rab*, a diluted form of gur,

¹ *I.S.J.*, 1921, p. 554.

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but the recovery of sucrose works out at only 4 per cent. as against the 9·5 per cent. of modern factories. The making of sugar in small factories is considered unsound, because of the impossibility of competing with large concerns; and in this finding the Committee is supported by the very interesting experiment recently concluded in the Government factory at Nawabganj in the United Provinces, which is somewhat thoroughly discussed.

The next chapter is devoted to the manufacture of gur, the native sugar of India. The best of this is made in the Meerut district, in the extreme west of the United Provinces, from indigenous canes, *Saretha* and *Dhanlu*, of a good class, in Bombay from *Pundia*, a fine thick tropical cane, and in the Godavari district of Madras from introduced Mauritius varieties. The worst gur is to be found in the eastern extreme of the United Provinces and the neighbouring districts of Bihar, and is made from *Henja*, the cane most used in the Bihar sugar factories; this inferior gur is the main raw material for the gur refineries in North India. An instructive table is given of analyses of the gurs from the chief gur tracts, from which it is seen that the sucrose varies from 62 to 87 per cent., while the glucose varies from 19 to 5. The crushing of cane in India was by pestle and mortar until the middle of the last century, but now in most places the three-roller bullock-driven iron mill has ousted all rivals. If properly adjusted, the extraction with this mill is quite good but, unfortunately, the cattle are often too weak to work it, and the mill is deliberately slackened on this account. Although the extraction of juice is naturally better in the peninsula where thick canes are grown, the average for all India only reaches 55 on 100 cane. Since one of the chief improvements in Indian agriculture is considered to be the introduction of modern ploughs of much heavier draught than the native ones, it becomes necessary to relieve the cattle of all heavy work in other directions, and this opens the way for the use of power for milling the cane and threshing of the *rabi* crops. Various efforts in the introduction of power mills have been made during recent years, and these are thoroughly discussed in the report; they have all been thus far unsuccessful from one cause or another, whether from ill-advised attempts to make sugar instead of gur, placing the cost of making the gur at too high a figure or locating the installations in wrong places. The Committee considers that the price charged for making a maund of gur in power mills should not be higher than 2 as. in Upper India and only 1 8 as. in the peninsula. The cost involved by the ryot in making his own gur does not enter materially into the calculations, because it is done in the main without any payment of money. To make the small power mills more effective the Committee recommends the addition of crushers, and suggests that suitable local designs should be worked out by the agricultural engineers attached to the provincial departments.

Boiling is very defective in gur making, chiefly because of the bad design of the furnaces and the consequent waste of heat. Very few of them, for instance, have a separate vent for the escape of smoke and gases of combustion. Several improved furnaces have been introduced from time to time, but there would still appear to be defects in all of them. Mr. CRAIB, an expert member of the Committee, has accordingly prepared a special design which is illustrated on plates XXIV and XXIVA of the report. From its complication we presume that this is only intended to serve for power plants. One of the most typical features of the native gur-making plants is the unbalanced nature of the milling and boiling sections, the latter being generally unable to keep pace with the crushing portion.

The manufacture of gur in large factories is considered by the Committee as worthy of investigation, although Mr. CRAIB doubts whether the factory-made

product will not be bereft of the harmless impurities which add so much to the flavour of the locally-made article. If this is the case, it will be a serious obstacle in the way of progress, excepting when the gur is to be used in refineries.

Chapters XIX and XX, which conclude Part II, deal with the making of white sugar in India, and contain much interesting matter. In 1919-20 the 18 factories working dealt with 337,000 tons of cane and produced 23,100 tons of sugar, which works out at 6.85 per cent. sugar to cane. The factories are small and inefficient, and one of the chief causes for this insufficiency is traced to the fact that none of them have a sufficient supply of raw material; 50 per cent. only crush half the capacity of their mills. The remedies for this serious defect are the purchase or leasing of land so as to have better control of supplies. The Committee is strongly against any compulsory acquisition of land, and it is recognized that it will be well-nigh impossible to obtain the necessary large blocks of land in any other way, excepting in the less developed provinces where comparatively little cane is grown. This throws us back on leasing land from the cultivators, which the Committee considers has been singularly neglected in India. In one case, that of Nellikuppam in South India, leasing is however readily effected, and the Committee thinks that this might with advantage be tried elsewhere. It is however pertinent to remark that Nellikuppam may be said to be in a quite peculiarly favourable position as compared with places in North India and, considering the importance attached to its example by the Committee, the causes of this may be briefly interpolated. In the first place, the comparative failure of the ground nut which is the universal staple of the district has made the cultivators eager for another crop all round the factory; in the second place the factory has discovered that the known large supplies of underground water are, in certain well defined areas, practically inexhaustible, and has been able therefore to erect great pumping installations and place them at the service of the ryots; then the kind of cane grown is a thick tropical one which gives very heavy yields and is practically free from disease; lastly, the firm has been interested in sugar cultivation in the district for the best part of a century, and has gained for itself a good name whereby all contracts are made much easier. These facts should be borne in mind when using Nellikuppam as an argument in favour of the ease with which the leasing of land is likely to be obtained in other less favoured parts.

In the tracts in North India where cane is grown on a large scale, the crux of the situation is to induce the cultivators to bring their cane to the factory instead of making it into gur. As already noted, they do not mind the trouble of making it into gur as long as no appreciable money has to be paid for this. What then can the factory afford to pay for cane? This question is very thoroughly gone into by the Committee and, from a study of the scale of pay for cane in Cuba and Louisiana, they have come to the conclusion that half the value of the sugar made is a suitable basis. They have accordingly worked out an elaborate sliding scale, illustrated by a diagram, for three classes of factories, inefficient ones which obtain only 5 parts of sugar from 100 cane, moderately efficient which obtain 7.5, and highly efficient which obtain 9.5, as is done in other advanced countries. Besides this, considering that gur is in most cases a natural competitor for the cane, they have added a curve of the price of cane which a ryot pays when making it into gur. The main lesson learnt from this diagram is that, where high class gur is made as in Meerut, a factory would have no chance, whatever its efficiency, whereas where gur is of a low class and the cane fetches a correspondingly low price, there is a good margin of profit and cane supplies can be obtained if a fair price is paid to the cultivator.

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A further chart has been prepared showing the details of the cost of making sugar in the most important exporting countries, together with such charges as are incurred in placing it on their natural markets. In the chart the costs of cane, manufacture, freight, and duty are separately given. The countries included are Louisiana, Porto Rico, Hawaii, Cuba, Java, and dear and cheap gur tracts in India. The chart deals with pre-war conditions, and instructive lessons can be drawn from it. We note that the cost of cane in places of high-priced gur in India is greater than anywhere else, except in Louisiana, while in those of low-priced gur it is also less than in Porto Rico and Hawaii. On the other hand, the cost of manufacture is greater in India than anywhere else. We congratulate the Committee on having placed this useful information in so convenient and striking a form. Most interest is naturally attached to the relative costs of sugar making in Java and India, for the first country is by far the largest source from which the Indian supplies are drawn. Furthermore, the cost of making sugar in Java is less than anywhere else, and if its competition can be met India need not fear for the future of its sugar industry. From the chart we see that the total cost of making sugar in India before the war was 106 85 as. per maund of 82 lbs., while that of Java including freight to India and duty on entering the country was only 81. This is a very considerable difference in Java's favour. But it must be remembered that there have been very considerable changes all round owing to the war and its inevitable sequelae. The costs in Java have risen a good deal, freights are much higher, and the duty has been materially increased. If, then, the cost of manufacture can be reduced in India by the installation of factories of a proper size capably managed, it is quite possible that the scale may be turned in India's favour, as the Committee thinks it will be.

The defects of the existing 18 factories in India are ruthlessly exposed in Chapter XX, and it would be difficult to imagine a more damning indictment. The high overhead charges in such small installations are of course a serious handicap but, besides this, from the moment the cane comes into the yard to the sending out of the finished product there are a series of avoidable losses. The old-time irregular arrival of the cane-laden bullock carts, dumping down their loads wherever they find a convenient bare space, throws the mill yard into confusion, and the Committee, after examining the up-to-date methods in vogue in Java and Cuba, decides that those of the former are more suited to Indian conditions. The mills are of old design, and mostly consist of one crusher and two 3-roller mills, often worked by separate engines. The bagasse is insufficient for boiling, and large quantities of coal and wood are added to it. The strainers and shallow pans are hand-cleaned, and much loss occurs in the filter-press mud. The labour employed in the mills is excessive, usually three or more to the 100 tons cane as against, for instance, the St. Kitts factory, where one man is employed for over 200 tons of cane. Many of these faults are traceable to the absence of control, whether agricultural or chemical, and the Committee advises the addition of an agricultural assistant to look after the even flow of supplies and an expert chemist, for, strange to say, such are rarely employed. Such a thing as complete chemical control is therefore absent, and nothing further need be said concerning the inevitable losses occurring all along the line of manufacture. This will doubtless be remedied if larger up-to-date factories are installed, and without these there appears to be little hope for the industry. The Committee furnishes a list of records which should, in their opinion, be kept in every factory, and that such a course should be considered necessary will at once show the backward state of the factories as a whole.

For the purpose of attracting capital and testing the various proposals made in the body of the Report, the Committee feels bound to advocate the erection of a pioneer factory in India. And they state their opinion that, as the exploiting of the favoured regions where land is available and better kinds of cane are grown will not, if successful, be sufficient to meet the demands for sugar, the factory should be placed in Upper India where the thin indigenous fibrous canes are grown. They tentatively select the Karnal-Rohtak region of the Punjab for a site for this factory, as this is a tract of concentrated cane growth, but this important point will doubtless receive further study before the site is finally decided on. They would prefer that the Government bear the cost, and have prepared attractive balance sheets, with sugar at Rs. 12 and Rs. 20 per maund, showing a profit of 9.43 per cent. and 26.83 per cent. respectively on the large capital outlay involved. Failing the supply of funds by the Government, which we hardly think will be agreed to, they suggest a loan with a Government guarantee of 7 per cent. The factory, in any case, would of course be on strictly commercial lines and no favour of any kind would be given that would not be accorded to any private company, the canes being bought from the cultivators or grown on land leased from them by the factory.

If the scheme is sanctioned by the Government, it will take about two years for the factory to be erected and some further time before its activities will be in a position to influence capitalists embarking in the industry; and it is thus obvious that the Committee see no easy road to success before the sugar industry in India. They have, we think rightly, refused to recommend the compulsory acquisition of land for growing cane supplies, but we also think that their refusal to recommend the licensing of factories, as is done in Java and Formosa, is rather more likely to defeat their object than to be, as they term it, a drastic interference with the rights of capital. The Committee have shown that a small factory can only afford to pay a much smaller sum of money for its cane supplies than a larger and more powerful concern: there is thus nothing to prevent small but well managed concerns from being swamped by larger factories who have noted their success with interest. This decision of the Committee is dissented from by the Secretary of the Sugar Bureau as well as by Mr. PADSHAW, and we hope that the Government will reconsider the matter in the light especially of Mr. WYNNE SAYER's short note on the subject. Small concerns will naturally be very shy of spending their money in erecting a factory, which may be rendered completely useless by more heavily endowed firms which can afford to pay considerably more for the cane supply which had been laboriously got together. The erection of ill-equipped small factories need not be feared if licenses are needed, for the Government would obviously have a good deal to say before granting any licence in a promising area. Mr. WYNNE SAYER's interesting short note shows that the cultivator would stand in no danger of being exploited by the system of licensing.

There is a great deal more of interest in the Report of the Indian Sugar Committee than we have space to deal with in the limits at our disposal. Part IV commences with a brief history of the various duties levied on foreign sugar entering the country, from pre-mutiny times to the present day. The duty at present appears to be higher than ever before but, as has been pointed out repeatedly, it is intended exclusively for revenue purposes, and the idea of protecting the industry, which it undoubtedly does, has had no influence on the authorities imposing it. The main portion of this part of the Report is taken up with the elaboration of the Committee's scheme for research, but the matter is not gone into in any great detail, and the main lines of work are drawn, for the

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Research Institute from Java and for the Sugar School from Louisiana. An interesting account of the Java scheme is given in Chapter II and has already been discussed in this Journal¹: similar accounts are drawn up by the Committee of the Sugar Schools in Louisiana and Hawaii. It is recommended that the sugar school should form an integral part of the Research Institute because of the great cost involved in making it self-contained as regards staff. We doubt, however, whether its inclusion in the Institute will not interfere with the pure research work of the officers to a greater extent than the Committee supposes. A considerable space is devoted to the management of the Research Institute, but very little is said about what it is supposed to do; but after all this is perhaps better so, for the Committee hardly has the knowledge of the industry which would warrant its going into detail. Much of the ground is also covered in other parts of the Report, and Java is held up as affording an example as to the kind of work to be done. More is said about the courses of instruction in the Sugar School, but here also the Committee prefers to intimate that further study of existing schools (and we would add of local needs) will be required.

Chapter XXIV deals both with the requirements of the Madras Presidency and the future of the Cane-breeding Station. We do not think that the Committee has been so successful in dealing with the southern province as elsewhere, there being a marked absence of the clear cut issues which are so characteristic of most of the other chapters. This is probably partly due to the Committee's recommendation that the officer in charge of the evolution of new kinds of cane for the northern tracts should also undertake purely local work, and the two are inextricably entangled. It is also a little difficult to make out what the Committee has in its mind, as there are quite a number of hypothetical cases introduced; but, from what we have been able to gather, the following are included in the duties of the new head of the Cane-breeding Station, who it is proposed should be recruited from home. In the first place, he is supposed to continue the researches in the morphology, growth and classification of the Indian canes which have been commenced; for an idea of the scope of this part of his work the reader may be referred to the five memoirs already published from the station; these cover a large ground and teem with suggestions as to future openings of work, which are not at all likely to appeal to a new officer, who will it is to be presumed have little knowledge of the sugar cane. The raising and study of seedlings for north India is to proceed as before but, in addition, a series of thick cane seedlings should be raised and similarly studied for Madras, Bombay, Assam and Burma. This mass of work is not apparently considered sufficient, for it is recommended that a Research Station should be opened by the same officer for the southern part of the Madras Presidency, with its small scattered areas of totally different conditions. On this Research Station special attention should be given to a thorough study of the duty of water for the cane in south India, although it may be doubted whether Coimbatore is altogether suited for this purpose. It is suggested also that a second breeding station should be opened under his general direction, the first botanical assistant being placed in immediate charge, thus depriving him of the experience gained by this officer, without which it will be very difficult for any newcomer to master the intricate details of work on the Coimbatore station. We fear that these proposals are impracticable, and may result in a less clear vision of what is really wanted in the north Indian tracts; for that, it will be necessary for the new officer to make extensive visits, as was done by his predecessor, over the main sugar tracts of India.

¹ *J.S.J.*, 1921, p. 493.

Similar criticisms might be made of the proposals for the founding of the various new stations which the Committee proposes for Madras, but there is less need for such a discussion when we consider that these proposals will presumably be submitted to the local authorities, before any such large expenditure is incurred. Dealing with the Cane-breeding Station itself the Committee opens with a short, clear résumé of its progress from the start. Certain points are then discussed in which principles of distribution of the seedlings obtained are laid down, both to the north Indian stations and by them in turn to the cultivators. The Committee seems to have very definite views as to the latter part of this distribution but, as that does not come within the purview of the station's work, we need not consider it further, excepting to observe that the exact method will doubtless vary with circumstances and may be safely left to the officers of the Research Institute to deal with.

In conclusion, we have no hesitation in welcoming this notable addition to the long list of works on the Indian sugar industry. In many parts a clear and logical exposé is given to a question which has for long puzzled those not in intimate touch with the agriculture of the country, and few of those who have been in such close touch have hitherto had the mass of facts before them which are so faithfully recorded in the Report. The Government of India is practically committed to take material action upon the Committee's proposals, and it will be of the greatest interest to see what they propose to do.

C. A. B.

The European 1921-1922 Beet Sugar Crop.

(By our Continental Correspondent.)

When speaking of the European beet sugar crop one must make a distinction between Russia and Ukraina (whence only very scanty news comes to us) and the other regions, most of which we have had the opportunity of visiting in the course of the past summer and autumn, or from which reliable reports have been received. In the great group of last-mentioned countries, the beet sowings have undergone an extension, which may be put at about 12½ per cent., or an increase from 997,500 hectares in 1920-21 to 1,125,500 in 1921-22.

As last winter was very mild in Europe and the spring began uncommonly early, the preparation of the beet-lands and even the sowing of beets was able to proceed very rapidly, and in many places the young beet plants made their appearance rather early in the season. In the month of April, however, a cold wave of long duration and great intensity stopped the development of the roots and even killed them on an extensive scale, so that many a tract of land had to be resown as soon as the weather permitted. Owing to the stoppage of growth and the delay in resowing, the advantage gained by the early spring was lost in the end, so that in May the beet-fields were in the same stage of development as in other years.

Yet an apprehension of pending evil was in the minds of the farmers, who noticed a general lack of moisture in the soil. The summer of 1920 had been very rainy, but in September of that year the sky became bright and remained so for a long time. Although occasionally rainshowers fell in the autumn and winter of 1920-21, the precipitation remained greatly below that of normal years, while at the same time almost no snow came down. Not only was the land too dry, but

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the rivers, which in other years carry off the melted snow from the mountains and bring moisture to the lower regions, contained very little water and rather drained the land instead of watering it.

At the outset, the beet growers were not greatly alarmed, since it was still expected that summer rains would make good what was lacking, the more so since the beetroot grows to a great depth and sends out its rootlets very far into the subsoil in quest of water, so that it may attain a good size in its downward development, at the same time remaining supplied with the necessary water for its full growth. If therefore summer and autumn rains bring moisture to the soil, the well-developed beetroot will profit by that supply and store a high percentage of sugar in its sap, thereby adding quality to the quantity already existing.

The rains, however, did not come off, and now even by December the Continent has not had much precipitation, while in other years the months of October and November are usually very rainy. Especially in the eastern and southern parts of Europe the lack of rain has made itself very badly felt, but in the countries of northwest Europe, in the vicinity of the Atlantic Ocean, the atmosphere was more charged with moisture and did not dry up the soil to so large an extent. The preliminary analyses made by the experiment stations and growers' associations in the months of August and September showed remarkably high sugar percentages in the roots, which caused the statisticians to assume a high sugar output per acre, although the weight of the beets might prove deficient, owing to their small size. We find in every European country till far in the month of September rather optimistic feelings, especially founded on the firm belief that before the beginning of the harvesting season good rains were sure to soak the land and to bring up the tonnage per acre to a normal level. Unfortunately this did not happen; the weather remained dry and the damage done by caterpillars, flies and other insect pests became worse every week, instead of decreasing as had been anticipated. As a consequence of the early ripening of the beets and of the very bright weather, the pulling of the roots started rather early, being also expedited by the fact that in many countries the manufacturers paid a premium for early delivery. The stocks of sugar in Europe had fallen to a very low amount, not enough in fact to last till the beginning of the usual slicing season, and for that reason manufacturers wanted to start early and paid more for early beets than for later ones.

They were fully entitled to do so; the public generally speaking wanted the sugar badly, the factories were in good working order, with their machinery renewed and extended since the conclusion of peace, while the supply of coal, limestone, bags, etc., left nothing to be desired. Finally, the workmen were willing, so that all the various troubles which had interfered with proper work during war-time were forgotten; manufacturers were eager to get to work once more and take off a good crop.

It soon appeared that the weight of beets reaped per acre was not coming up to the mark, because there were large empty patches in the fields and the roots were on the small size. Moreover, in many places the soil was so hard that the lowermost parts of the beetroots broke off during pulling and remained stuck in the ground, thus causing considerable loss. In the second place the lack of cattle food occasioned by the drought induced beet growers to cut off large sections of the root while topping them to increase thereby their fodder supply, to the detriment of the sugar production. Further, the beets thus ill-treated were unfit for preservation over any long period either in silos or on heaps, especially as, during the entire month of October the temperature throughout Europe was far above the normal. We have heard on our travels many complaints about the keeping

quality of the early pulled and badly stored beets, which showed large rotten portions and even big holes in the body of the root. Finally the high sugar content of the beets did not find a corresponding equivalent in the output of sugar on 100 parts of beet. It appears that owing to the dry soil, much water had been abstracted from the root tissues, thereby concentrating the juice to an uncommonly high percentage, but at the same time preventing its proper ripening. Some constituents, which hinder the extraction of sugar from the juice and which in ripe beets have already passed away still remained in the roots and interfered with the working up of the juice into sugar. The boiling of the syrups has encountered many difficulties and the amounts of molasses and of sucrose lost in that by-product are much larger than could have been expected. The high sugar content of the roots does not therefore mean a correspondingly high rendement and consequently does not make up for the low tonnage of beets.

During the month of October the work in the factories went on without a hitch; and we have seen very satisfactory daily outputs in many sugar factories, so that the campaign will not be a long one this time. During the last week of November, however, a severe frost, unaccompanied by snow, reigned over Europe, causing beets, left outside, to freeze and interfering with water traffic. We do not know if this very early frost will have the effect of prolonging the campaign owing to the suspended transit, but this point has still to be taken into account when estimating the probable results of the crop.

At any rate it has, as far as now, not come up to the optimistic anticipations of the beginning of this year and, in every probability it will attain an only slightly better result than last year's. We give here the probable results of the 1921-22 crop, expressed in thousands of metric tons, raw value, together with the first estimates of this year and with the final crop of 1920-21:

COUNTRY	1921-22 PRESENT ESTIMATE.	EARLY ESTIMATE.	1920-21 CROP.
Germany	1268	1500	1109
Czecho-Slovakia	606	650	715
Austria	20	16	14
Hungary	50	60	33
Poland	200	207	171
France	254	300	338
Netherlands	310	350	317
Belgium	246	280	243
Italy	222	200	122
Spain	117	117	238
Denmark	155	149	137
Sweden	253	228	164
Other countries	88	110	61
TOTAL	3789	4167	3662

Reports have come to us from Russia, but the truth of them we are unable to check; they speak of a sugar production in 1920-21 to the amount of 90,000 tons, while for this year an output of 75,000 is expected. If, under every reserve, we assume these figures to be exact, the total European sugar crop of 1921-22 will attain to 3,864,000 tons, against 3,752,000 in the previous season.

As the requirements of Europe (exclusive of Russia), are about 5,900,000 tons, this part of the world will need an importation from other places of a little over two million tons. The sugar from Java will very probably, for by far the greater part, be absorbed by the countries in the Far East and by India, so that only Cuba, Mauritius, the French colonies, and the British West Indies with Demerara can be called upon to remedy this big deficit.

On the Selection of Engine Sizes for Cane Milling Plants.

By AN OCCASIONAL CORRESPONDENT.

The power required for milling a given quantity of cane will depend on :—

1. The quantity of fibre in the cane ;
2. The nature of the fibre in the cane ;
3. The structural condition of the cane ;
4. The pressure under which the mills operate or the opening in the case of rigid mills ;
5. The mechanical efficiency of the system of engine, gearing, and mill.

The engine size will depend on all the above factors, and in addition, will be controlled by—

6. The mean effective pressure under which the engines operate ;
7. The margin of safety, or what Professor PERRY has called, the factor of ignorance.

Evidently the quantity of fibre is a more reliable basis than cane, but this datum is still insufficient since all fibre is not of the same nature. Roughly, the fibre may be divided into the soft interior pith and the hard outer rind. From variety to variety not only does the quantity of fibre vary, but so does its distribution among these two classes, and generally canes with high fibre are found also to possess a greater proportion of hard rind tissue.

Of experimental observations of record, the following data are available :—

BOLK,¹ in Java, gave the following results when operating on 37·4 short tons of cane per hour :—

	VARIETY POJ 100 I.H.P.		VARIETY BOURICIUS 247 I.H.P.
Crusher	60	....	74
Mill I.. .. .	80	....	95
„ II	65	....	75
„ III.. .. .	75	....	82

If POJ 100 had 11 per cent. fibre and Bouricius 247 had 13 per cent., these figures reduce to 19 I.H.P. per short ton-fibre-hour-mill (*t.f.h.m.*), treating the crusher as a mill.

DEERR,² in Hawaii with Lahaina cane of 12·7 per cent. fibre and 50 short tons per hour, found :—

	1 H.P. AVERAGE.		I.H.P. MAXIMUM.		MAXIMUM AVERAGE.
Crusher and Mill I	184	..	218	..	1·19
Mills II, III, IV	372	..	443	..	1·19

These figures reduce to 18 I.H.P. *t.f.h.m.*

HERRIOT,³ quoting figures from Cuba, gives 1103 I.H.P. as obtained with 80 long tons cane per hour in a crusher and six-mill plant. If this cane had contained 10 per cent. fibre, as is commonly found with Crystalina cane in Cuba, this result indicates 18 I.H.P. *t.f.h.m.*

These three results are in reasonably close agreement.

SEARBY,⁴ however, gives results from 13 mills in Hawaii which, if referring to the standard Hawaiian practice of a crusher and four mills, reduce to 22 I.H.P.

¹ Paper read at Ninth Java Congress, 1911.

² *Cane Sugar* (1921), p. 191.

³ Paper read before the Manchester Association of Engineers, March 12th, 1921.

⁴ Hawaiian Sugar Planters' Association, Report on Manufacturing Machinery, 1918.

t.f.h.m. In his results a certain number of abnormally low and excessively high figures appear, but nevertheless the average is distinctly higher than that of the three first quoted more or less concordant observations. It is probable, however, that in these last results much Yellow Caledonia (White Tanna) cane was milled, and this is a type of cane containing much rind tissue and very resistant to milling.

In design, therefore, it would be well to treat of softer and of harder canes separately. For softer canes let 25 I.H.P. per short ton-fibre-mill-hour be the maximum power to be developed, and for harder canes let 30 I.H.P. be the corresponding figure. The allowance here suggested over and above that actually determined from experiment as an average is intended to include once and for all the margin of safety. As a basis of design let the lowest permitted steam pressure at engine throttle be 0.75 of that pressure at which the boilers blow off, and let the engines be capable of developing the maximum necessary power at this pressure and at 40 per cent. cut off. Let the back pressure be 10 lbs. gauge. Then, if the boilers blow off at 120, 100, and 80 lbs. gauge, the lowest permissible pressures will be 90, 75, and 60 lbs. gauge, and under the conditions suggested as a basis of design, the mean effective pressures will be 56, 45, and 33 lbs. per sq. in. respectively.

In the formula $I.H.P. = \frac{P L A N}{33,000}$ express L in inches, A in terms of the diameter d , and put $N = 100$ (50 r.p.m.). Then, if as is very often the case with the type of engines used to drive cane mills, $L = 2d$, the formula becomes $I.H.P. = \frac{P d^3}{2520}$, where P is the mean effective pressure, and where the sectional area of the piston rod is neglected. Then, for softer canes, $25nf = \frac{P d^3}{2520}$, and for harder canes $30nf = \frac{P d^3}{2520}$, where n is the number of mills driven off one engine and f is the short tons of fibre per hour to be milled.

These formulae reduce to the form $d = K \sqrt[3]{\frac{3}{nf}}$, where K is a constant depending on the boiler pressure and the nature of the cane. Following on the argument presented above, the subjoined values of K result:—

Boiler Pressure = P . Lbs. sq. in.	M.E.P. at 0.4 cut off and Gauge Pressure = 0.75 P . Lbs. sq. in.		VALUE OF K .	
			Softer Canes.	Harder Canes.
120	56	10.4	11.1
100	45	11.2	11.9
80	33	12.4	13.2

Very possibly with canes of the Uba type some increase in capacity even over that found for harder canes might be desirable.

From the suggested formula the engine size expressed in terms of the diameter and with stroke equal to twice the diameter can be found. That standardized size most nearly approximating in power thereto would be installed.

Figures obtained in a cane sugar factory in a French colony have been published,¹ showing the analysis of the juices obtained by filtration through (a) a mechanical cloth filter, and (b) a Raimbert sand filter, these being for the 1915 campaign as follows:—Density, 1058.20, 1057.80; sugar, 11.19, 11.24; purity, 75.81, 76.56. During the 1921 campaign, the purity values were 75.90 and 76.53 respectively for the two filters; and the average purity figures resulting from 40 tests made in the case of the syrups gave 80.87 and 81.16 for the two filters in the order named above.

¹ *Journal des Fabricants de Sucre*, No. 42, October 21st, 1921.

Juice Heater Calculations.

By P. H. PARR.

It is now fairly well known that the mean temperature of juice, during the time of flowing through a juice heater, is not the arithmetic mean between the initial and final temperatures, and that such an assumption may lead to serious errors: the logarithmic formula—as old as logarithms—is also now in regular use, but the writer has not yet seen it in print in the form which he has found to be most convenient, while there are useful deductions to be made, which apparently have not been published, and which it is the subject of this article to illustrate. One difficulty here surmounted is that of determining the value of the heat transmission coefficient from the test results of a double, or compound, juice heater, the two heaters working with different steam pressures, and when the intermediate juice temperature between the heaters has not been measured.

Let S_1 = steam temperature in the first heater,

S_2 = „ „ „ second heater,

J_1 = juice temperature entering first heater,

J_2 = „ „ „ leaving „ „ and entering second heater,

J_3 = „ „ „ second heater,

Δ = mean temperature difference between the juice and the steam in the heater,

$\Delta_1 = S_1 - J_1$ = initial temperature difference in first heater,

$\Delta_2 = S_1 - J_2$ = final „ „ „

$\Delta_3 = S_2 - J_2$ = initial „ „ „ second heater,

$\Delta_4 = S_2 - J_3$ = final „ „ „

θ = coefficient of heat transmission, B.Th.U. per sq. ft. per hour per °F. mean temperature difference.

$W = \frac{\text{lbs. juice per hour} \times \text{specific heat}}{\text{sq. ft. surface in one heater}}$

$a = \frac{\theta}{W}$ (a is a measure of the rate of heating).

Then the most useful forms of the ordinary logarithmic formula are as follow, where $\exp. a$ (exponential a) is the same thing as e^a , e being the base of the natural system of logarithms:—

$$\Delta = \frac{\Delta_1 - \Delta_2}{\log_e \frac{\Delta_1}{\Delta_2}} \quad (1)$$

for the first heater, and the same formula, but with Δ_3 and Δ_4 in place of Δ_1 and Δ_2 , for the second heater.

$$\left. \begin{aligned} \Delta_1 &= \frac{\Delta_1}{\exp a} \\ \Delta_2 &= \frac{\Delta_2}{\exp a} \end{aligned} \right| \quad (2)$$

$$a = \log_e \frac{\Delta_1}{\Delta_2} = \log_e \frac{\Delta_3}{\Delta_4} \quad (3)$$

Next, $\Delta_2 = S_2 - J_2 = \Delta_2 + S_2 - S_1 = \frac{\Delta_1}{\exp. a} + S_2 - S_1$, and $\Delta_4 = \frac{\Delta_1}{\exp. a}$ so that:—

$$* \Delta_4 = \frac{\Delta_1}{\exp. 2a} + \frac{S_2 - S_1}{\exp. a} \quad (4)$$

giving directly the final temperature of the juice leaving the second heater.

* $\exp. 2a = (\exp. a)^2$ or e^{2a} .

The final question is the determination of the value of the heat transmission coefficient, or of a , from which θ follows at once, when the intermediate temperature J_2 is not known. For this purpose we may re-write equation (4) as:—

$$\Delta_4 \exp. 2a - (S_2 - S_1) \exp. a - \Delta_1 = 0$$

or, which is the same thing:—

$$\Delta_4 e^{2a} - (S_2 - S_1) e^a - \Delta_1 = 0$$

in which form it is perhaps more readily seen that the equation is a simple quadratic in $\exp. a$, or e^a , and the solution is evidently:—

$$\exp. a = \frac{S_2 - S_1 + \sqrt{(S_2 - S_1)^2 + 4 \Delta_1 \Delta_4}}{2 \Delta_4}$$

or, taking logarithms:—

$$a = \log_e \frac{S_2 - S_1 + \sqrt{(S_2 - S_1)^2 + 4 \Delta_1 \Delta_4}}{2 \Delta_4} \quad (5)$$

the positive value of the square root being the only one here in question.

We will now consider a few examples of the many uses of these formulæ, which solve most questions with much greater facility than might be expected, and will take the case of a single heater first. Suppose we have 4000 gallons of juice per hour, with an initial temperature of 80°F. and a specific heat of 0.95, and wish to find the temperature to which it will be raised on passing through a juice heater of 250 sq. ft. surface, working with exhaust steam at a pressure of 5 lbs. per sq. in., for which $S_1 = 228^\circ\text{F.}$, the coefficient of heat transmission being $\theta = 200$. We have $W = 4000 \times 10 \times 0.95/250 = 152$, and $a = 200/152 = 1.32$, so that $\exp. a$, or e^a , is $e^{1.32} = 3.74$ (being the number whose natural logarithm is 1.32). The initial temperature difference is $\Delta_1 = 228 - 80 = 148$, and formula (2) at once gives $\Delta_2 = 148/3.74 = 40$; thus the temperature of the juice leaving the heater will be $J_2 = 228 - 40 = 188^\circ\text{F.}$

Then we may ask what must be the surface of the heater if the final juice temperature is to be 200°F., other conditions remaining the same? We now have $\Delta_1 = 148$ as before, and $\Delta_2 = 228 - 200 = 28$; formula (3) gives $a = \log_e \frac{148}{28} = \log_e 5.3 = 1.67$, so that $W = 200/1.67 = 120$, and the surface must be $40,000 \times 0.95/120 = 317$ sq. ft.

The heater with 250 sq. ft. surface is found on test to heat the juice to 170°F. only; what is the coefficient of heat transmission? We have $\Delta_1 = 148$ as before, and $\Delta_2 = 228 - 170 = 58$; formula (3) gives $a = \log_e \frac{148}{58} = 0.936$, so that $\theta = aW = 0.936 \times 152 = 142$ B. Th. U.

We next come to the double, or compound, heaters, and may ask what will be the final juice temperature if the heater of the first example is followed by a second, of the same size, but working with a steam pressure of 25 lbs. per sq. in., for which $S_2 = 267^\circ\text{F.}$ If we take the result of the first example, that $J_2 = 188^\circ\text{F.}$, we have $\Delta_3 = 267 - 188 = 79$, and from (2), $\Delta_4 = 79/3.74 = 21$, and the final juice temperature will be $J_3 = 267 - 21 = 246^\circ\text{F.}$ Otherwise, we can obtain the result directly by the use of formula (4), which gives:—

$$\Delta_4 = \frac{148}{3.74} + \frac{267 - 228}{3.74} = 10.6 + 10.4 = 21^\circ \text{ F., the same as before.}$$

To find the surface if the final temperature of the juice is to be 240°F, we have $\Delta_1 = 148$, $\Delta_4 = 267 - 240 = 27$, and $S_2 - S_1 = 267 - 228 = 39$; equation (5) then gives us;—

Juice Heater Calculations.

$$a = \log_e \frac{39 + \sqrt{39^2 + 4 \times 148 \times 27}}{2 \times 27} = \log_e 3.17 = 1.154,$$

from which $W = 200/1.154 = 173$, and the surface must therefore be $40,000 \times 0.95/173 = 220$ sq. ft. for each heater.

These last heaters of 220 sq. ft. each, after being in use for a few days, are found to heat the juice to 220° F. only; what is then the rate of heat transmission? We have $\Delta_1 = 148$, $\Delta_4 = 267 - 220 = 47$, and $S_2 - S_1 = 39$ as before; therefore:—

$$a = \log_e \frac{39 + \sqrt{39^2 + 4 \times 148 \times 47}}{2 \times 47} = \log_e 2.24 = 0.806,$$

giving $\theta = aW = 0.806 \times 173 = 139$ B.Th.U.

It is not convenient to stop working for cleaning, but the juice must be heated to 240° F., and the steam pressure in the second heater is to be increased so as to effect this; what must now be that pressure? We must first find the temperature of the juice from the first to the second heater, for which we have $\Delta_1 = 148$, exp. $a = 2.24$ from the last example, $\Delta_2 = 148/2.24 = 66$, and $J_2 = 228 - 66 = 162^\circ$ F. For the second heater, $\Delta_3 = S_2 - 162$ and $\Delta_4 = S_2 - 240$; equation (2) gives us exp. $a = \Delta_3/\Delta_4$, or $2.24 = \frac{S_2 - 162}{S_2 - 240}$, from which we readily find $S_2 = 303^\circ$ F., requiring a steam pressure of 55 lbs. per sq. in.

A number of examples have been given, each illustrating a different point, in order to show the facility with which the various questions arising in connexion with juice heaters can be solved by the formulae, and which is seldom at first appreciated by engineers, who are not usually accustomed to working with formulae of the present type. The only difficulty in practice arises from the natural logarithms and the exponentials, but this difficulty is far more apparent than real. On a log-log slide rule, either logarithms or exponentials can readily be found, while most engineers have a table of natural logarithms: the small *Five Figure Tables of Mathematical Functions*, by DALE (Ed. Arnold, London, present price 4s 6d.) gives both nat. log. and exp. tables, and so does the latest (1921) edition of *Kempe's Engineer's Year Book*, but any table of nat. logs. is sufficient when it is remembered that if $y = \log_e x$, then exp. $y = e^y = x$, so that exp. y is simply the number for which y is the natural logarithm.

It may be remarked that no use has been made of formula (1) for the mean temperature difference, which is the basis of nearly all of the older articles on heaters, and is usually the only formula given: the fact is, that we are practically never concerned with the mean temperature difference as such, but only with the initial and final temperature differences, and to make a special calculation for Δ , in which we are not interested, is a circuitous route to the solution of most problems. The other formulae solve many problems that (1) will not solve at all, such as our first example, where the final juice temperature has to be found, and compound heater questions; and they give the results directly.

The Government of India have decided to appoint a Fiscal Commission to examine with reference to all the interests concerned the tariff policy of the Government of India, including the question of the desirability of adopting the principle of Imperial Preference, and to make recommendations. The Commission will assemble at Bombay in the first half of November and will visit the more important commercial and industrial centres of India for the purpose of taking oral evidence, completing this part of its work probably early in March, 1922. It will submit its report to the Government of India as soon thereafter as possible.

An Interesting Example of the Resistance of Java Seedling Canes to Frost Damage.¹

By WM. E. CROSS and SALVADOR DELASCIO.

On many occasions we have pointed out the remarkable resistance of the Java seedling canes, now generally planted in this province, to frost damage, especially when they are cultivated as ratoon canes. In the year 1918 for example, the following temperatures were registered in the grounds of this Experiment Station :

14th June	27°F	9th July	24·8°F
7th July.. .. .	23°F	10th July	27·6°F
8th July	19·7°F	11th July	27·4°F

and nevertheless, as we pointed out in a previous report,² the ratoon canes which were harvested so late as the end of August, while all the buds were quite killed, proved entirely suitable for milling.

Having finished the harvest of that year, it occurred to us that it might be worth while to investigate the deterioration which would be suffered by such frozen canes if they were left standing until the early months of summer, and we resolved to take advantage of the first occasion that presented itself to carry out such an investigation. Seeing that the year 1920 also turned out to be one of heavy frosts, we left standing after the harvest of that year a plot of cane for the purposes of this experiment. The plot contained all the Java seedling varieties commonly planted in this province, viz.: POJ 36, POJ 213, POJ 228, POJ 234, and also the interesting variety Kavangire.

The minimum temperatures to which the cane was subjected were the following :

9th July	29·3°F	15th July	25·7°F
13th July.. .. .	24·2°F	16th July.. .. .	29·3°F
14th July	24·8°F		

A snowfall was also experienced on the 13th July, the snow remaining on the cane for the better part of a whole day.

As the result of these severe conditions, the leaves and buds of all the cane in the Experiment Station were entirely frozen, and the ordinary tropical varieties of cane quickly began to deteriorate due to the decomposition caused by the frost, as the following table of analyses made on the 23rd-26th September shows:—

TABLE I.
ANALYSIS OF FROZEN CANE (RATOONS),
23rd to 26th September, 1920.

VARIETY.	BRIX.	SUCROSE.	GLUCOSE.	PURITY.	AVAILABLE SUGAR.	ACIDITY. ³
Red Native	9·65	5·00	0·72	51·81	2·6	0·057
Striped	11·51	7·94	0·88	68·98	5·4	0·048
Manteica	9·01	3·25	2·00	36·07	1·1	0·085
B 347.. .. .	10·51	6·58	0·92	62·60	4·1	0·040
H 27	8·83	2·55	1·63	28·87	—	0·105
L 44	10·03	3·95	2·18	39·38	—	0·077
D 74	11·43	8·34	0·39	72·96	6·0	0·036

¹ From the *Revista Industrial y Agrícola de Tucumán*, Vol. XI, Nos. 9-10.

² *Ibid.*, Vol. IX, p. 102 (1918) and Vol. X, p. 143 (1920).

³ Acidity in terms of a normal solution.

Example of Resistance of Java Seedling Canes to Frost Damage.

The canes in the special plot which were left standing were analysed at frequent intervals during the months of October, November, and December, the "topping" of these canes for analysis being carried out entirely in the normal manner, or at the most one or two joints lower than normal. The results of the analyses are shown in Table II.

From this Table it will be seen that there was no doubt that the cane had been killed by the frosts, as when the warm weather of the late Spring set in, the fermentation of the cane was rapid. The interesting point is nevertheless that these Java varieties, even when once killed by the frost, are slower to suffer destructive fermentation than the more tropical varieties.

TABLE II.

ANALYSIS OF FROZEN CANES (RATOONS)						OCTOBER—DECEMBER, 1920.			
Variety.	Date.	Brix.	Sucrose.	Glucose.	Purity.	Available Sugar.	Acidity (normal)		
POJ 36	Oct. 7	15.77	13.39	0.12	84.90	12.4	0.032		
	" 14	14.82	12.88	0.13	86.90	12.1	0.027		
	" 21	14.71	12.77	0.27	86.81	12.0	0.025		
	Nov. 4	11.53	9.61	0.23	83.34	8.6	0.020		
	" 18	11.30	7.80	1.45	69.02	5.3	0.020		
	Dec. 2	9.85	5.84	1.25	59.28	3.4	0.020		
	" 23	8.57	5.15	1.46	60.09	3.1	0.020		
POJ 213	Oct. 7	14.27	11.80	0.66	82.69	10.8	0.020		
	" 14	13.85	10.62	1.13	76.67	8.1	0.030		
	" 21	13.01	10.18	0.87	78.24	9.0	0.020		
	Nov. 4	11.35	8.50	0.80	74.88	6.3	0.018		
POJ 223	Oct. 7	15.22	12.77	0.25	83.90	11.7	0.025		
	" 14	14.57	12.45	0.23	85.44	11.6	0.025		
	" 21	13.91	11.85	0.25	85.19	11.0	0.028		
	Nov. 4	12.99	10.72	0.24	82.62	9.8	0.015		
	" 18	11.55	8.05	1.33	69.79	5.6	0.030		
	Dec. 2	11.75	7.65	1.40	65.10	4.9	0.040		
	" 23	10.72	6.66	1.41	62.12	4.1	0.026		
POJ 234	Oct. 7	13.17	11.30	0.20	85.80	10.5	0.018		
	" 14	13.22	11.30	0.18	85.47	10.5	0.021		
	" 21	11.91	8.50	1.32	71.36	6.0	0.035		
Karangire	Oct. 7	14.62	12.15	0.18	83.10	11.1	0.027		
	" 14	15.72	12.91	0.39	82.12	11.7	0.026		
	" 21	14.21	11.83	0.36	83.25	10.8	0.022		
	Nov. 4	11.88	9.3	0.43	78.28	8.2	0.017		
	" 18	12.75	10.26	0.66	80.47	9.2	0.020		
	Dec. 2	11.10	6.37	1.20	60.99	4.1	0.024		
	" 23	10.29	5.41	1.25	52.67	2.8	0.017		
	Feb. 20	8.86	3.25	2.44	36.68	1.2	0.036		

It is interesting to compare these results also with those obtained by analysing unfrozen canes left standing during the second year of growth.¹ In this latter case it was shown that the canes suffer practically no loss in purity during the whole of the second year, but that a parallel diminution of Brix and Sucrose (or increase in the water content) takes place during the rainy season, these values increasing again almost to their original amount when the dry season of late autumn and winter sets in.

Finland's beet sugar crop for the 1920-21 campaign amounted to 8187 metric tons, as compared with 5015 tons in the previous season.

¹ *Revista Industrial*, Vol. XI, Nos. 7-8 (1921).

The Colloids of Cane Juice, and their Separation by Means of Plauson's Process of "Ultra-Filtration."

COLLOID NATURE OF CANE JUICE.

When all the grosser particles of suspended matter in cane juice have been removed by some suitable means, as by straining through very fine metal gauze, or glass wool, a dim liquid is obtained, the turbidity of which is due to matter in the colloid state.

In certain well-known experiments, NOËL DEER¹ separated these colloids by filtration in the cold through a pad of asbestos; but he found this a very tedious operation, quite incapable of being applied on the technical scale, owing to the very slow rate of filtration, even when high pressures were employed. DEER observed, however, on heating the bright filtrate that only a trace of precipitate appeared, which fact indicated that colloid filtration separates the same bodies as are coagulated by heat. He further showed that in the defecation process of clarifying cane juice only about 28 per cent. of the purifying process can be considered to be due to the chemical action of the lime, the rest being attributed to the elimination of the colloids by coagulation on heating and by adsorption during settling. Dr. PRINSEN GEERLIUS² has also emphasized the importance of the colloids in juice clarification; and has remarked in substance that the essential result of the two most effective methods, namely sulphitation and carbonatation, is not so much to remove any great amount of impurities, as partly to eliminate the small amount of colloidal matter present in the juice.

The great importance of a technical method of removing the colloids from cane or beet sugar juices is therefore made clear. It would result in the separation of the gums and pectins, the albuminoids, and a portion of the colouring matters, so that it would be possible to obtain clear and light-coloured syrups, capable of being exhausted easily to a low degree of purity. It would simplify the process of sugar manufacture, and greatly improve the product obtained.

It is therefore of extreme interest to notice that H. PLAUSON, a Russian physical chemist, has invented what he terms an "ultra-filter," by means of which it is stated to be possible to separate the colloids from any liquid on the technical scale in a convenient, economical, and continuous manner.

LABORATORY SEPARATION OF COLLOIDS.

This invention was introduced to the notice of technologists by G. SCHMITT³ in an instructive article, from which it is worth while making a few excerpts, in order to give a general idea of the nature of the problem. He pointed out that a liquid (such as sugar juice) may contain matter in three different states of dispersion: (1) coarse dispersion, that is, containing rather coarse suspended matter (0.001 mm. diam.), capable of being separated by means of fine gauze; (2) colloids (0.001-0.00001 mm., or $1\ \mu$ - $0.01\ \mu$); and (3) molecular dispersoids (under $0.01\ \mu$) such as a solution of sodium chloride (common salt), in which case it has hitherto been impossible to effect separation by any form of filtration.

In the case of the colloids, it is possible by various laboratory devices to effect their separation, but generally only with much difficulty. Thus, a clay filter, the diameter of whose pores are 0.00041-0.00016 mm., may be used for the coarser colloids, or ordinary filter-paper treated with collodion, for those more highly dispersed. Among other filters that may be used for so-called "ultra-filtration,"

¹ *I.S.J.*, 1916, 502.

² "Practical White Sugar Manufacture," pp. 62-63.

³ *Chemiker Zeitung*, 1920, 44, 657-658.

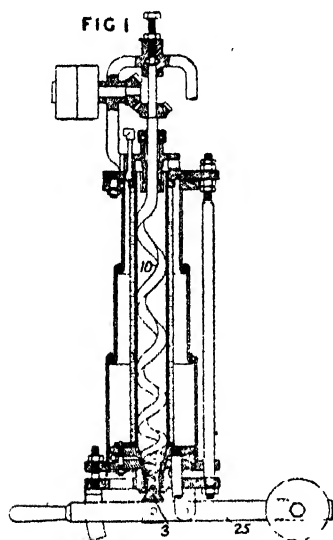
The Colloids of Cane Juice and their Separation.

that is the separation of the very highly dispersed colloids, may be mentioned Zsigmondy and Bachmann's "Diaphragm Filter"; but while an improvement on other laboratory methods, it is only suitable for dealing with relatively small quantities of liquid, and is out of the question for technical purposes.

PLAUSON'S METHOD OF "ULTRA-FILTRATION."

The PLAUSON apparatus is constructed upon entirely different principles, which may now be briefly considered. A medium is provided capable of resisting a pressure up to 200 atmos. per sq. cm., and provision is made for continuous operation. Further, the rate of filtration remains constant, or nearly so.

The manner in which these advantages is realized is shown in the patent specification,¹ from which the accompanying illustration (Fig. 1), depicting the general form of the filter, is taken. It is constructed of a cylinder made of coarsely perforated sheet metal, upon the outer surface of which finely perforated plates (Fig. 2) or rings are superimposed, and pressed down by means of screw-nuts.



These plates may have narrow elongated slots, and the adjacent plates may be arranged so that the slots of one are at right angles to those of the other. A filtering element having fine pores is thus constructed, and the size of the pores can be varied at will by altering the degree of compression of these plates or rings. In order to remove the slimy film collecting on the inner surface of the cylinder, a worm 10 is provided having a decreasing pitch towards the discharge end, which is closed by a cone 3 on a counter-weighted lever 20. As the result of the action of the continuously operating worm gear, the slime collecting on the inner surface of the perforated cylinder is removed; but an even layer of slime remains between the outer edge of the worm gear and the filtering surface. It is this surface which really forms the filtering medium, the stable body of the filter serving only as the frame for it. If the pores formed by the superimposition and compression of the perforated plates and rings are insufficiently small, their

size can be reduced by means of fibrous material deposited previous to filtration, the filter surface thus being coated with a felt-like film.

It is claimed² that this colloid filter possesses the following advantages:—It operates rapidly and continuously; it can be adjusted for the separation either of coarse particles or of the finest colloid suspensions; its wear and tear is extremely small; pressures up to 200 atmos. per sq. cm. may be applied; it gives a clear filtrate; the coefficient of percolation (volume of liquid per unit of time) remains constant; the moisture in the residuum which is discharged from the filter from time to time can be reduced very considerably; and skilled labour is unnecessary.

Regarding its application to the filtration of juice, BERTHOLD BLOCK,³ in a lecture delivered at Magdeburg, stated that trials were about to be made on the

¹ U.K. Patent, 155,834; *I.S.J.*, 1921, 594.

² *Deut. Zuckerind.*, 1921, 46, No. 40, 556-558.

large scale. He said that it should be possible to filter raw beet juice without the addition of any lime, or perhaps with the addition of only 0.5 per cent. so as to decompose the non-sugars. Molasses, filtered after treatment with quite a small amount of "Carboraffin," ran through the filter almost completely clear and odourless. Especially was its viscosity low, the slimy colloids having been retained by the filter. Diffusion waste-waters can be filtered bright, so that their return to the battery becomes possible. Beet syrup can be obtained from the root directly by means of this filter.

The introduction of the Plauson press into the sugar industry, it was added, would simplify, improve, and cheapen the work.

The Plight of the Sugar Industry in Soviet Russia.

Like all other branches of industry in Soviet Russia, the sugar industry is in a state of utter collapse. The present production of sugar is only 5 per cent. of the pre-war figure. In 1920-1921 the output was 90,850 tons, as against 1,740,000 tons in 1914-1915 (*Moscow Pravda*, Sept. 10th).

The principal cause of this catastrophic decline in production is mismanagement, or rather, the complete economic anarchy which is the direct consequence of the Bolshevik economic system. No one is personally interested in the success of the sugar industry. This industry, which requires a high standard of technical education, is managed by an enormous staff of inexperienced officials, for whom filling in forms, etc., is of more importance than the actual condition of the industry under their charge.

The report on the state of the sugar industry, published in the above-mentioned issue of the Soviet newspaper, is an interesting instance of the results of Bolshevik experiments on Russian industries.

It appears that the area under sugar beet has been reduced by nearly 75 per cent., i.e., from 1,881,900 acres in 1914 to 486,882 acres in 1920. This reduction is owing to the fact that the peasants, who in 1917 seized the sugar beet plantations, do not see the use of growing sugar beet, as the nationalized sugar factories pay a mere trifle for the raw material delivered.

Moreover, it is not only the crop area that has been reduced: productivity has likewise fallen. First of all, in an incredibly large majority of cases the crops have failed. The *Ekonomicheskaya Zhizn* (Sept. 15th) reports that, whereas even during the War the crops failed only on 2 per cent. of the whole area under beet, in 1920 the percentage rose to 18 per cent. The productivity fell from 95 cwts. per acre in 1914 to 25 cwts. in 1920. In 1914 the output of sugar per acre of beet harvested was 18.1 cwts., as against only 4.1 cwts. in 1920. The Soviet organizations, however, were unable to harvest even this crop, so insignificant when compared with that of former years. For instance, of last year's beet crop of 1,080,000 tons, "over 200,000 tons remained unharvested in the fields and were stolen piecemeal."

Even when brought to the sugar factory, however, the beet is not wholly utilized for sugar, or rather, it is utilized imperfectly. Production is constantly delayed, "which affects the quality of the beet."

As regards the manufacture of the roots into sugar, matters are perhaps even worse. The factories are almost in ruins. Frequently several different Soviet institutions claim the right to manage them. As there is no owner the plant, already worn out, is systematically looted.

The Plight of the Sugar Industry in Soviet Russia.

There is a shortage of labour because the Soviet organizations do not provide the workers with necessities of life in sufficient quantities. Moreover, there have been cases when the workers were taken from sugar works for compulsory work at some other branch of industry. True, the converse is possible, i.e., sometimes workers are taken from other industries to work at sugar factories. It all depends on what branch of industry is favoured by the commissar who mobilizes and distributes the workers.

There is no fuel. At present the sugar factories have only one-twentieth of the fuel required (*Ekonomicheskaiu Zhizu*, Sept. 15). As a result of such a state of affairs, the average output of a sugar usine in 1920-1921 was 437 tons, as against 7171 tons in 1914-15 (*Moscow Pravda*, Sept. 10th).

Such a decline of production, however, must be explained by poor work. It appears that the Soviet organizations have been obliged to re-start a considerably greater number of works than there is raw material for, because if the production of sugar were to be concentrated in a few factories, it would be impossible to provide enough sugar beet for them, as the peasants will not bring it from a distance, while the railways have other things to do besides transporting beet. For instance, this year the Bolsheviks will have to re-start 104 factories (out of a total of 235), whereas according to their own words the whole of the expected beet crops could be absorbed by 13 establishments (*Ekonomicheskaiu Zhizu*, Sept. 15th).

The current year will be a harder one for the sugar industry than its predecessors, and the prospects of sugar production are gloomier than ever. The *Ekonomicheskaiu Zhizu* (Sept. 15th), states that the original area of the ruined beet crop forms 54.9 per cent. of the total crop area. It appears that of a total of 554,000 acres the original failure of the crop affected 291,600 acres, but then part of this area was re-sown, and by the end of the summer there were 448,000 acres of beet.

According to the newspaper above-mentioned, the drought and noxious insects were the principal causes of the failure of the crops. "There is no doubt," says this periodical, "that both the drought and noxious insects had such a bad effect only because the area in question had not been properly tilled." Thus, even should the beet be harvested, transported to the factory and manufactured, the output of sugar will still not exceed 60,000 tons, i.e., will be only 66 per cent. of last year's output. But of course there will be more unharvested beet left in the fields than there was last year, as the peasants will be still less interested in supplying it, in view of the fact that the Soviet Government has still less to give them in return for it than last year. Moreover, the operations of the factories themselves will be still worse hampered by the shortage of labour and fuel, which is greater this year than last.

The causes which have led to such a lamentable state of affairs in the sugar industry lie of course in the economic system of the Bolsheviks, and therefore one can hardly hope for any improvement unless there is a radical change in that insane system.

A bronze calandria to be used in the construction of the large evaporator to be installed in the Pioneer Sugar Mills, Lihue, Maui, T.H., was recently cast by the Honolulu Iron Works, Honolulu.¹ Its dimensions are 14 ft. 2 in. diam. and 38 in. deep, with a 27½° slope, its weight being 6360 lbs. It has 560 holes of 4 in. diam. for the copper tubes, and it is said that 10,000 lbs. of metal were charged for pouring, representing a large sum at the present prices of bronze.

¹ *Sugar News*, 1921, 2, No. 9, 379.

The Nature and Composition of Cane Molasses.¹

By W. D. HELDERMAN.

THEORIES OF MOLASSES FORMATION.

According to the oldest theory, cane molasses was regarded as a supersaturated solution of sugar contaminated by the presence of substances which impart to it such a viscosity that the crystallization of the sugar is hindered. This consideration, which had its origin in investigations on beet molasses, in which per unit of water more sucrose is present than can dissolve in the same quantity of pure water, seemed fairly obvious, though a great drawback to it was the fact that a crystal of sugar can grow well in a very viscous gelatinous solution. Moreover, one can crystallize an osmized molasses, in which the emulsoid colloids, generally inducing a great increase in the viscosity, have been concentrated. When later cane molasses was more closely examined, and when it was found that per unit of water less sucrose was dissolved in it than in pure water, this theory was doomed to be abandoned.

An actual systematic examination was not possible at that time (the seventies and eighties), because the theory of equilibrium and of solution was insufficiently developed.

Different investigators, KOHLER,² DEGENER,³ HERZFELD,⁴ DUBRUNFAUT,⁵ MARSHALL,⁶ PRINSEN GEERLIGS,⁷ and many others determined the influence exerted by different salts, invert sugar, glucose, etc., on the solubility of sucrose in water; and the expressions "positive molasses-former" and "negative molasses-former" originated as the result of the observed fact that some non-sugars increase the solubility of sucrose in water, and others diminish it, while many salts in small concentration were noticed to have a lowering effect upon the solubility, and an augmenting one when present in larger amount. There is no reason for discussing all these researches in detail here, and the conclusions drawn from them can be summed up in the so-called "chemical theory of molasses."

GEERLIGS' THEORY.

GUNNING⁸ early endeavoured to explain the influence exerted by the non-sugars upon the solubility of sucrose by the formation of compounds between these substances; and it was principally PRINSEN GEERLIGS⁹ who elaborated this theory and endeavoured in different ways to support it. His hypothesis may be summarized in a few words as follows:—

Molasses is a hydrated combination of sugars and salts, which on the concentration of its solution does not decompose, and from which therefore no further crystallization of sugar can occur. In these combinations the different sugars are capable of being substituted. Glucose, for example, can displace sucrose, so that, by the addition of glucose, part of the sucrose can be liberated from combination, thus becoming crystallizable.

KÖHLER¹⁰ found that in general the solubility of sucrose in a solution of non-sugar, and also the solubility of non-sugar in a sucrose solution, are mutually in

¹ Abridged translation from the *Archiv*, 1921, 29, No. 34, 1249-1254.

² *Verzeichnisschrift*, 107, 441. *Ibid.*, 47, 441. *D. Z. I.*, 22, 148, 1320.

³ *D. Z. I.*, 20, 2149. *Verzeichnisschrift*, 46, 533.

⁴ *Verzeichnisschrift*, 42, 182, 240, 768.

⁵ *Ann. Chim. physique*, 47, 411.

⁶ *Verzeichnisschrift*, 20, 328, 619; 21, 57; 23, 218.

⁷ *Rec. des Trav. Chim. des Pays Bas*, 280. Also "Cane Sugar and its Manufacture." (NORMAN RODGER, London.) Page 301 *et seq.*

⁸ *Österr.-Ungar. Zeitsch. Zuckerind.*, 7, 356. ⁹ "Cane Sugar and its Manufacture," page 301, *et seq.*

¹⁰ *Loc. cit.*

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such a relation that the solubility of each is influenced in the same direction; in other words, if sucrose dissolves in a non-sugar solution more than in pure water, the said non-sugar also dissolves in a sucrose solution more than in pure water. In explanation of this, it was stated that when sucrose and salt are present in sufficient amount a compound forms, which, depending upon the nature of the salt, is more or less soluble in water than the components.

It should therefore result in the case where both components occur in such quantity that they can combine together that the solubility of the constituents should be regulated by that of the compound formed, and not by that of the respective bodies in an uncombined state. Thus, DAEGENER¹ found that the lowest solubilities of salt and sucrose in solutions of these two in water correspond with the formula $\text{NaCl} + 4\text{C}_{12}\text{H}_{22}\text{O}_{11}$ for the sodium chloride compound, and with $\text{CaCl}_2 + 2\text{C}_{12}\text{H}_{22}\text{O}_{11}$ for the corresponding calcium chloride body.

PRINSEN GEERLIGS² examined the influence exerted by invert sugar upon the solubility of sucrose alone and together with salts. He found that, while invert sugar alone did not alter the solubility of sucrose, in the simultaneous presence of invert sugar and salts, the solubility of sucrose was diminished. He came to the conclusion for different reasons that in the sucrose-salt combination the sucrose is either wholly or partly replaceable by reducing sugar, which sets it free, so that it becomes crystallizable. In order to prove this, he made solutions of sucrose and potassium acetate in water, which was saturated in respect of the sucrose. After equilibrium had occurred, it was found on the addition of glucose that sucrose again separated from the saturated solution.

In addition to the investigations already mentioned, very many others were made in order to furnish the proof of the existence of sugar-salt compounds, a very thorough account of which will be found in Prinsen Geerligs' book.³

At this point, attention may be drawn to the phenomenon that when acetic acid is added to a molasses, sucrose is deposited after some time. Adherents of the combination theory here sought a proof of their hypothesis on the ground that the acetic acid decomposed the compounds formed, liberating the sucrose, and allowing it to crystallize.

However, from investigations carried out at the Experiment Station it would appear that the quantity of sucrose obtained in this way is equal to the fine grain already present in the molasses. Owing to the diminished viscosity (the result of the addition of acetic acid and perhaps also of the flocculation of the colloids) this sugar settles out, and can be recovered. Some of the results obtained here follow, it being understood that in such tests no great accuracy can be attained, so that the grain content found by Kalshoven's method does not absolutely correspond with the amount of crystal obtained by acetic acid:—

KIND OF MOLASSES USED.				GRAIN CONTENT BY KALSHOVEN'S METHOD.	CRYSTALS DEPOSITING ON ADDING ACETIC ACID.
Defecation	..	..	..	8.7	7.5
"	....	....	....	4.4	7.9
"	..	..	..	7.9	9.3
"	....	....	....	12.7	11.1
Sulphitation	..	..	..	5.7	8.6
"	....	....	....	16.3	14.7
Carbonatation	..	..	..	2.1	2.4
"	....	....	....	9.6	9.6
"	..	..	..	15.2	12.9

¹ D. Z. I., 20, 2149.

² Loc. cit.

³ Loc. cit.

Lately, the molasses question has come to the front again, and has given rise to different investigations. Thus, VAN DER LINDEN¹ has examined it from the point of view of the phase rule, in order to ascertain whether or not such compounds are formed. At the same time the question was examined whether molasses should be regarded as a eutectic mixture, undercooled or not; or, again, either as a stable or as a metastable sucrose solution. Particulars will be found in the original literature referred to.

This investigation was carried out at the Experiment Station; but a decisive conclusion could not be drawn from it. Work by KALSHOVEN² showed later that the microscopically fine grain occurring in varying amount in most Java molasses had vitiated the result, necessitating a new series of experiments taking this grain content into consideration, which can now be done by the method elaborated by KALSHOVEN.³

MODERN VIEWS OF THE NATURE OF MOLASSES.

Let us now see to what extent the experiments and conclusions which have given rise to the molasses theory of combination may be regarded as valid in the light of our present knowledge of physical chemistry. In regard to the conclusion drawn from Kohler's investigation,⁴ it appears that to explain the mutual influence of sucrose and non-sugars on the solubility, it is quite unnecessary to assume the formation of compounds. This would follow mathematically from thermodynamic considerations, propounded both by ROTHMUND⁵ and by NERNST⁶ without any special supposition regarding the molecular condition of the substances concerned. Here, however, is not the place to discuss these matters in detail.

That, further, from the composition of the solutions examined by DEGENER, showing the lowest solubility for sucrose with sodium chloride and sucrose with calcium chloride, one should conclude that compounds are formed is certainly not correct. In ternary systems, consisting of a liquid and two solid substances, if a compound forms, solutions of different concentrations at a certain temperature can exist in equilibrium with the compound.⁷ Therefore, from the composition of a solution alone nothing can be concluded regarding the composition of the solid phase.

Regarding further the investigations of PRINSEN GEERLIGS, in which it was found that invert sugar alone has no influence on the solubility of sucrose, whereas invert sugar and salts present simultaneously decrease the solubility, it must be remarked that his results in so far as the influence of invert sugar is concerned are not wholly correct. From VAN DER LINDEN's research⁸ examining the influence of invert sugar, as well as from a solution curve determined by the writer in respect of sucrose with gradually increasing quantities of glucose, it clearly appears that the solubility of sucrose is diminished by the addition of glucose or invert sugar. That this was not observed by PRINSEN GEERLIGS is to be ascribed to the following causes: (1) He used no thermostat, which was not quite possible at the time at which the experiments were made; and (2) equilibrium in such viscous sucrose solutions sets in very slowly, some days being necessary. Moreover, it has been shown in different communications originating from the Experiment Station¹⁰ that neither sucrose nor glucose is in the position to form compounds with salts which at 30° C. constitute a solid phase in equilibrium with their saturated solutions; while further repetition of the work carried out by VAN DER LINDEN

¹ *Archief*, 1915, 1033 and 1339.

² *I S.J.*, 1920, 38.

³ *Ibid.*

⁴ *Loc. cit.*

⁵ *Zeitsch. f. Elektrochemie* 1901, 7, 875.

⁶ *Zeitsch. f. phys. Chemie*, 1902, 38, 487.

⁷ *Loc. cit.*

⁸ *Archief*, 1920, 1708, line CD in Fig. II.

⁹ *Archief*, 1919, 591.

¹⁰ *Ibid.*, 1920-21, 1701, 2305.

The Nature and Composition of Cane Molasses.

has shown¹ that Java molasses cannot be regarded as an under-cooled eutectic mixture, but as a saturated sucrose solution.²

Again, it has recently appeared that the conclusion from the chemical molasses theory that a so-called "exhausted" molasses gives no more sucrose on further concentration, but only loses water of hydration, is untrue.³

On the contrary, it was demonstrated in the case of every molasses examined that sucrose crystals deposited on the elimination of water, though the rate of crystallization was extremely slow, while the crystals were frequently microscopical, and capable of being determined only by Kalshoven's method⁴ with very viscous molasses, the process can be hastened after concentrating by shaking in the presence of large crystals of sugar during some days. After straining through bronze gauze, it was found that the sucrose content of the molasses had diminished, from which it was concluded that sucrose had deposited upon the crystals added.

In conclusion, therefore, the sum total of the matter appears to be that, according to our present knowledge of the properties of solutions, no urgent reason exists for regarding molasses as a hydrated sugar-salt compound. On the other hand, the latest investigations have shown such compounds to be unstable in solution.

As the definition of a true molasses in equilibrium, we can give the following: *Molasses is a solution saturated in sucrose, the solubility of which is influenced by the presence of various substances, such as invert sugar, salts, and other substances, colloidal and crystalloid.*

In this definition, and in the facts upon which it is based, an explanation is also to be found for the difference in the sucrose solubility of cane and beet molasses. The high invert sugar content of Java molasses causes a sucrose solubility below the normal. On the other hand, beet molasses possesses only a small content of invert sugar, but a high proportion of various salts, which cause the sucrose solubility to be increased above the normal value.

There has been a discussion in the French Press as to whether refiners' profits were not unduly large.⁵ Before the war the margin between raw and refined varied between 8 and 12 francs per 100 kilos, and refiners were quite satisfied with a profit of 5 francs per 100 kilos, in fact did very well on this. At one time recently the margin was about 130 francs per 100 kilos. It remained steady in the neighbourhood of 100 francs for many months, and even now is about 80 francs. Refiners reply that their costs of working have increased enormously, and that their profit is little greater than before the war. But a competent engineer points out that while costs have increased in the proportion of four to one, the margin has increased eight or ten to one.

There are only five beet sugar factories in Bulgaria, all of which are owned and entirely operated by joint stock companies. The capacity of the largest factory at Rustchuk, expressed in the number of metric tons of beets worked per 24 hours, is 1400, while the smallest has a capacity of but 500 tons. Beets are grown under contracts between the planters and the sugar factories, which are based upon the market price of sugar at the time the contracts are made, and are not dependent on the quality of the roots.

According to *Production and Export*, the Government of British Guiana has decided to remit the tax of 1 per cent. on sugar exports in order to give effect to a request of the sugar planters for relief in the economic crisis with which the colony is faced. The tax was originally $1\frac{1}{4}$ per cent., and was intended to increase the fund to provide for the colonization of British Guiana.

¹ *Loc. cit.*

² *Archief*, 1921, 181.

³ Regarding this point, reference should be made to the controversy occurring in our columns. See *I.S.J.*, 1917, 90, 159, 297, 568; 1918, 88, 328; 1919, 138; 1920, 649.—*EDITOR, I.S.J.*

⁴ *Loc. cit.*

⁵ *Journal des Fabricants de Sucre*, No. 42, October 21st, 1921.

Chemical Control Results of Ten Philippine Centrals. (1920-1921 Crop.)

Milling Season—

	Oct. 18 ..	Jan. 19 ..	Jan. 12 ..	Nov. 2 ..	Dec. 27 ..	Nov. 25 ..	Nov. 11 ..	Jan. 15 ..	Dec. 31 ..	Nov. 23 ..
Began ..	Apr. 30 ..	June 3 ..	May 24 ..	Mar. 31 ..	June 2 ..	May 17 ..	June 17 ..	June 10 ..	June 22 ..	May 21 ..
Finished ..	Oct. 18 ..	Jan. 19 ..	Jan. 12 ..	Nov. 2 ..	Dec. 27 ..	Nov. 25 ..	Nov. 11 ..	Jan. 15 ..	Dec. 31 ..	Nov. 23 ..
Cane—										
Polarization ..	10.38 ..	14.08 ..	14.46 ..	11.31 ..	13.33 ..	12.25 ..	12.02 ..	13.77 ..	14.71 ..	13.55 ..
Fibre, per cent.	9.55 ..	11.80 ..	12.00 ..	13.90 ..	10.03 ..	11.20 ..	11.37 ..	11.35 ..	11.46 ..	11.80 ..
Tons cane per ton sugar ..	9.27 ..	8.21 ..	8.10 ..	10.65 ..	8.79 ..	9.48 ..	9.61 ..	8.53 ..	8.01 ..	8.51 ..
Tons cane per hectare plant ..	— ..	— ..	33.4 ..	{ 51.82 ..	— ..	49.0 ..	28.61 ..	31.15 ..	— ..	— ..
Tons cane per hectare ratoon ..	— ..	— ..	— ..	{ 23.02 ..	— ..	19.0 ..	— ..	— ..	— ..	— ..
Sugar—										
Tons manufactured ..	5,065.30 ..	5,613.24 ..	13,067.09 ..	7,390.67 ..	10,078.45 ..	14,520.61 ..	19,377.41 ..	15,130.76 ..	5,644.54 ..	18,861.61 ..
Polarization ..	96.20 ..	94.58 ..	96.50 ..	96.63 ..	96.51 ..	96.06 ..	96.00 ..	96.12 ..	96.55 ..	— ..
Moisture, per cent.	— ..	1.0 ..	— ..	0.94 ..	1.3 ..	0.94 ..	0.88 ..	1.021 ..	1.164 ..	— ..
Ash, per cent.	— ..	— ..	— ..	— ..	— ..	0.43 ..	— ..	0.302 ..	— ..	— ..
Juice—										
Brix of first expressed ..	19.00 ..	20.00 ..	20.50 ..	16.80 ..	19.53 ..	17.94 ..	18.80 ..	19.28 ..	19.73 ..	19.10 ..
Apparent purity of first expressed ..	82.90 ..	85.50 ..	85.90 ..	84.00 ..	82.53 ..	81.05 ..	79.68 ..	85.76 ..	85.76 ..	82.10 ..
Brix of last mill ..	14.50 ..	8.50 ..	4.30 ..	4.40 ..	6.87 ..	4.28 ..	4.60 ..	6.61 ..	7.19 ..	4.07 ..
Apparent purity of last mill ..	76.37 ..	73.40 ..	73.20 ..	71.80 ..	69.80 ..	69.39 ..	63.94 ..	75.95 ..	75.94 ..	68.80 ..
Brix of mixed juice ..	18.20 ..	17.50 ..	15.80 ..	13.71 ..	18.21 ..	15.83 ..	15.83 ..	15.65 ..	14.17 ..	17.20 ..
Purity of mixed juice ..	81.10 ..	82.90 ..	83.90 ..	81.69 ..	80.18 ..	78.46 ..	76.21 ..	83.65 ..	83.82 ..	79.60 ..
Syrup—										
Brix ..	51.90 ..	60.40 ..	64.20 ..	58.80 ..	64.80 ..	55.64 ..	63.47 ..	65.68 ..	67.11 ..	64.20 ..
Purity ..	84.55 ..	84.60 ..	86.40 ..	84.10 ..	82.24 ..	79.03 ..	78.87 ..	82.98 ..	83.83 ..	81.40 ..
Bagasse—										
Polarization ..	6.21 ..	4.22 ..	4.10 ..	3.01 ..	4.31 ..	2.17 ..	2.65 ..	3.71 ..	4.43 ..	5.17 ..
Moisture, per cent.	47.70 ..	47.87 ..	47.80 ..	47.80 ..	47.00 ..	47.50 ..	45.11 ..	47.38 ..	48.46 ..	— ..
Press Cake—										
Polarization, per cent.	— ..	6.17 ..	0.90 ..	3.89 ..	11.06 ..	3.81 ..	4.58 ..	5.98 ..	10.47 ..	3.84 ..
Polarization, per cent, cane ..	— ..	1.51 ..	1.20 ..	1.78 ..	1.40 ..	1.73 ..	1.53 ..	2.00 ..	0.99 ..	— ..
Final Molasses—										
Gravity solids ..	— ..	81.80 ..	84.20 ..	86.50 ..	89.80 ..	87.32 ..	89.28 ..	85.59 ..	84.10 ..	88.70 ..
Apparent purity ..	30.40 ..	38.50 ..	— ..	— ..	33.26 ..	34.86 ..	— ..	31.63 ..	35.91 ..	30.00 ..
Gravity purity ..	— ..	— ..	45.50 ..	37.33 ..	41.02 ..	39.26 ..	36.50 ..	39.99 ..	43.02 ..	— ..
Mill—										
Hours of actual grinding ..	3,087.50 ..	1,187.90 ..	2,313.35 ..	1,796.15 ..	1,966.57 ..	2,130.40 ..	3,100.24 ..	2,048.03 ..	1,631.42 ..	2,719.50 ..
Grinding time, per cent. total time ..	57.83 ..	95.91 ..	93.21 ..	93.21 ..	92.80 ..	91.17 ..	91.52 ..	92.58 ..	— ..	— ..
Total cane per hour ..	15.20 ..	38.70 ..	45.80 ..	43.80 ..	45.13 ..	64.59 ..	60.03 ..	63.94 ..	27.70 ..	59.44 ..
Extraction per cent. sucrose in cane ..	90.12 ..	92.37 ..	92.60 ..	92.31 ..	92.85 ..	96.96 ..	93.46 ..	93.54 ..	93.46 ..	92.17 ..
Dilution per cent. normal juice ..	4.01 ..	10.20 ..	29.70 ..	29.50 ..	8.30 ..	9.93 ..	15.23 ..	12.22 ..	8.39 ..	8.50 ..
Mill Equipment—										
Sets of knives ..	— ..	1 ..	1 ..	— ..	1 ..	2 ..	1 ..	2 ..	1 ..	— ..
Number of crusher rolls ..	2 ..	2 ..	2 ..	2 ..	3 ..	2 ..	2 ..	3 ..	2 ..	— ..
Number of mill rolls ..	9 ..	9 ..	9 ..	9 ..	12 ..	12 ..	15 ..	12 ..	9 ..	— ..
Size of mill rollers ..	— ..	— ..	34 × 78 in. ..	36 × 84 in. ..	34 × 78 in. ..	34 × 78 in. ..	34 × 78 in. ..	34 × 78 in. ..	34 × 78 in. ..	34 × 78 in. ..

* Weights marked thus indicate short tons, otherwise metric tons are understood.

The Analysis of Products containing Sucrose by the Neutral Double Polarization Method.

By C. L. HINTON, F.I.C.,

Chemist in charge of the Analytical Department, British Association of Research for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades, London.

Arising out of the publication by R. F. JACKSON and C. L. GILLIS,¹ of the Bureau of Standards, of methods for the determination of sucrose by the neutral double polarization process, Dr. C. A. BROWNE has recently criticized the methods and formulæ of these authors on certain grounds which he claimed had been ignored in the working-out of the process.² To these criticisms Dr. JACKSON and Miss GILLIS have replied.³ Much of the controversy is occupied by the elaboration of arguments based on an effect, which, if it exists in theory, is in all probability negligible in practice. The discussion and experimental results arising from this tend to obscure the fact that Dr. BROWNE does finally draw attention, in a somewhat indirect manner, to what amounts to a serious error in the evaluation of the Clerget divisor for use in the methods of the Bureau of Standards. It is with the object of showing more directly where the latter are open to real criticism that the present contribution to the discussion is made.

Dr. BROWNE endeavoured to show that the depressing effect of a given concentration of salt (ammonium chloride, sodium chloride, etc.) on the polarization of sucrose and of invert sugar is not constant, as stated in Scientific Paper No. 375, but varies according to the ratio of salt to water, which is itself governed by the concentration of sugar in the solution examined. JACKSON and GILLIS at first fell back upon the rather doubtful and vague defence that if such an effect existed it would be more or less quantitatively compensating in the positive and negative constituents of the Clerget divisor. They further published results to show that the effect found for concentrations of 26 grms. sucrose in 100 c.c. held good also at concentrations below 7 grms. in 100 c.c.

When later BROWNE showed that the variation of effect could only be quantitatively compensating at one particular concentration, about 13 grms. in 100 c.c., JACKSON and GILLIS carefully examined the effect of a constant quantity of ammonium chloride on the rotatory power of sucrose of concentrations from 5 to 52 grms. in 100 c.c. and found that no appreciable variation existed. Further, they indicated the possibility of errors in Browne's results which, if allowed for, would bring his figures into line with their own, as showing a constant salt effect for wide ranges of concentration of sucrose. It is thus unnecessary to assume any compensating effect as assumed and discussed by BROWNE.

In his last paper Dr. BROWNE described experiments in which considerably higher proportions of salt (20 grms. in 100 c.c.) are added to sucrose solutions, and finds evidence for a difference in effect with different concentration of sucrose. Since such large amounts of salt are far beyond any amount used in the analytical process, it can, however, be accepted, as found by JACKSON and GILLIS, that the effect of the salt added in their Clerget process is for all practical purposes constant. The probability that this is true is strengthened by the fact that an increase in concentration of invert sugar itself by a definite amount is not greatly different in dilute and in more concentrated solutions; indeed, it is usually taken as being constant. Thus, an addition of a further 1 gm. in 100 c.c. invert sugar

¹ Scientific Paper No. 375. *I.S.J.*, 1920, 509, 570, 638.

² *I.S.J.*, 1921, 186, 276, 516.

³ *I.S.J.*, 1921, 217, 445.

to a solution containing 10 grms. in 100 c.c. of invert sugar increases the specific rotation by 0.053° ; whilst the same addition to a solution of 20 grms. in 100 c.c. causes an increase of 0.045° , according to Gubbe's correction for concentration:—

$$(\alpha) \frac{20}{D} = -19.447 - 0.06068p + 0.000221p^2.$$

In the methods of the Bureau of Standards the concentration correction for inverted sucrose is taken as being constant, and equal to 0.0676° S. per 1 gm. in 100 c.c. difference in concentration. Dr. Browne's contention that the addition of a small quantity of salt to a 20 per cent. solution of sugar would have an appreciably greater effect than its addition to a 10 per cent. solution is therefore not easy to understand.

Having endeavoured to exaggerate the disputed salt effect by reference to amounts of salt quite outside the range of any analytical requirements, BROWNE then abandoned this point and proceeded to discuss a much more definite error in the Bureau's methods.

The divisor of the Jackson-Gillis modification of the Clerget method is made up of a positive and a negative constituent. The former, depending almost entirely on the sucrose in the solution, is practically independent of differences of concentration up to the normal strength solution. The negative part, however, varies considerably for different concentrations of invert sugar in any solution examined.

The Bureau's methods require the use of the negative constituent corresponding to a concentration equal to the *amount of sucrose inverted in the analysis*. In the examination of such a mixture as sucrose-invert sugar, however, the negative constituent must depend on the total concentration of invert sugar in the inverted solution, and not on any arbitrary fraction of it. Thus, if a mixture of 13 grms. of sucrose and 13 grms. of invert sugar in 100 c.c. be inverted, the inverted sucrose will have a rotation corresponding to a concentration of about 26 grms. in 100 c.c., requiring that the negative part of the divisor should also correspond to this concentration. JACKSON and GILLIS, however, would use a factor corresponding to a concentration of 13 grms. in 100 c.c., implying that a part of the invert sugar has a different rotation to that of the remaining part. BROWNE uses an indirect method of bringing out this error, by showing that a solution of 13 grms. in 100 c.c. of inverted sucrose in presence of 13 grms. of dextrose has practically the same specific rotation as a solution of 26 grms. in 100 c.c. of inverted sucrose. He insists still that it is the changing effect of the NH_4Cl which accounts for the differences, whereas, as shown above, there appears to be scanty ground for supposing the effect to be different at 26 grms. in 100 c.c. from its effect at 13 grms. in 100 c.c. Moreover, the rotation of invert sugar in admixture with dextrose is a matter for very careful investigation, and it might be argued that the effect of 13 grms. in 100 c.c. dextrose is not the same as an additional 13 grms. in 100 c.c. invert sugar.

Whatever may be the case with dextrose, however, it is impossible to argue that in an inverted sucrose-invert sugar mixture the invert sugar from the original sucrose has a rotation different from that of the remaining invert sugar in the same solution. The divisors used must then, as BROWNE points out, be based on the *total* concentration of sugar in the inverted solution, and not on the $(P - P')$ value. This renders some of the figures published by JACKSON and GILLIS open to serious criticism. In Table 5 the erroneous $P - P'$ value of the divisor has been used for calculating the sucrose,¹ and yet the sucrose found agrees

¹ *I.S.J.*, 1921, p. 448.

The Analysis of Products containing Sucrose.

with the sucrose taken. This is a result difficult to understand, and unfortunately JACKSON and GILLIS do not give their actual direct and invert readings in order that the source of error may be traced. However, a comparison can be made of the divisors used in Table 5 and those which would be more correct.

COMPARISON OF DIVISORS.

Solution.	B. of S. Method.	Basic Value of		Concn of Inverted		Correction for Concentration.	Correction for Temperature.	Required Divisor.	Divisor used in Table 5.
		Divisor.	of	Sucrose in Inverted Solution.	Solution.				
1	.. II	.. 133.34	..	17.2	..	+ 0.28	.. + 0.02	.. 133.64	.. 133.45
2	.. IV	.. 132.63	..	15.6	..	+ 0.18	.. + 0.00	.. 132.81	.. 132.52
3	.. IV	.. 132.63	..	14.0	..	+ 0.07	.. - 0.04	.. 132.66	.. 132.22
4	.. II	.. 133.34	..	11.6	..	- 0.09	.. - 0.15	.. 133.10	.. 132.56

It will be seen that the errors range from 0.15 per cent. to 0.4 per cent. of the sucrose determined, so that the sucrose found in a sample would be too high. Where stronger solutions were examined the errors would, of course, be increased. The only conclusions which can be drawn are that either the $P - P^1$ values of Table 5 are incorrect, or that there is some other factor affecting the divisor which has hitherto been overlooked in the methods of Scientific Paper No. 375.

In connexion with the above remarks it is interesting to note that JACKSON and GILLIS did carry out one experiment in which they showed that invert sugar, in presence of sucrose, produces about the same rotation as it does if the sucrose is inverted.¹ Further, W. C. VOSBURGH² has shown that the specific rotations of sugars in a mixture are those which they would have at concentrations equal to the total sugar concentration in the mixture. This is stated to hold well for mixtures of dextrose and sucrose, and of dextrose and levulose, but is only approximate for mixtures of fructose and sucrose. It may be mentioned also that other physical properties of solutions of mixed sugars, such as density and refractive index, possess this additive effect of concentration.

Thus it seems evident that the Clerget divisors must be corrected, not for any arbitrary amount of sucrose in the uninverted solution, but for the total concentration of sugars. Obviously also, as JACKSON and GILLIS point out, the direct and invert polarizations should be made at the same concentration of total substance, in order to avoid the effect of change of concentration on any invert sugar originally present.

When the basic values of the divisors worked out by JACKSON and GILLIS, which allow sufficiently for the effect of the salt, are corrected for concentration in the proper manner as shown above, it will be possible to test the real value of the neutral polarization method. But so long as figures are published showing apparently correct results when using erroneous corrections for the divisor, it is impossible to say where, if at all, the methods as applied to mixed sugar products may be at fault.

Summarizing, then, the alleged variation of salt effect with different concentrations of sugar in the modified methods of Clerget analysis published by the Bureau of Standards is in all probability negligible as regards the amounts of salt used in these methods. The divisors, however, must be corrected for the total concentration of sugars in the solution polarized.

Mr. FRANZ HERLES, Editor of the *Zeitschrift für Zuckerindustrie der czechoslovakischen Republik*, has been awarded the degree of doctor of technical science by the Technical High School of Prague.

¹ Scientific Paper No. 375, p. 173.

² J. Amer. Chem. Soc., 1921, 43, 219.

Noël Deerr's "Cane Sugar."

II.

THE ENGINEERING SIDE OF THE INDUSTRY.

As was pointed out last month,¹ Deerr's well-known work dealing with the agriculture of the cane, the manufacture of sugar from the cane, and the analysis of sugar-house products has now been completely re-written, excepting only the chapter on fermentation, and portions of the sections dealing with manuring, husbandry, analysis, and chemical control.

Last month an impartial and critical review from the pen of an agricultural specialist was given. An impression of the value of the engineering side of the book by a well-known sugar factory engineer here follows.

The engineering side of the cane sugar industry is pretty fully dealt with in the latest edition of "Cane Sugar"; and not unnaturally it is to this section of the book that the reader will turn for the greatest changes from the first edition; nor will he be disappointed since this part has been very fully revised and re-illustrated. There are 12 chapters devoted to this particular branch of the industry. All of these have been practically re-written; and at the outset it may be stated that they contain much information, to a large extent original, which will be highly appreciated by the sugar factory engineer.

Chapter XI has been particularly well put together. It now gives a systematic account of the development of the 3-roller mill. There is a good discussion on the trash-turner and its adjustment, and similarly instructive sections on pressure regulators; gearing; motive power; capacity; setting; the composition of cane as affecting extraction; and the economic limit of extraction.

This chapter on Milling also contains some very valuable additions in the shape of graphs and tables that should prove most useful to all responsible for the setting and operation of multiple mills. But, by way of well-meant criticism, it may be remarked that a little more detail might have been given as to what the figures in these graphs stand for. Again it may be mentioned that the author does not give any details as to the method used in comminuting the cane or as to the fineness to which it is reduced; and we are of the opinion that this will be found to have considerable importance in the matter of comparative power required for juice extraction. When the cane is shredded or beaten out, as is the case with the swing-hammer type of machine, it yields up its juice more freely and with less pressure, especially in the higher stages of pressure, than where the cane has been broken down or cut up by rollers with specially prepared surfaces, such as multiple crushers. It would appear that the efficiency of the molecular locking-in of the juice is very appreciably affected by the difference in the character of the particles of cane under pressure. In the one case the cell walls are more likely to be torn and disrupted and also separated from the long fibres, than in the other case where groups of cells may be merely cut off and compacted under pressure with a film of sugar juice between.

In the matter of giving relief and protecting the mill in the event of hard foreign matter entering with the feed, hydraulic pressure as usually applied at present gives only indifferent service, owing to the extra reactionary pressure on the rams necessary to overcome the friction of the pressure water in the pipes

¹ I.S.J., 1921, 637.

between the raw chambers, and to the force necessary to accelerate the accumulator weights. A pneumatic pressure device, patented by J. BLAKESLEY, of Victoria Street, London, S.W., recently brought to the writer's notice, would appear to offer much more prompt easement to the mill with equal steadiness of pressure under normal conditions of grinding.

Two types of juice strainer now in use are dealt with by the author; it seems advisable to lay emphasis on the importance of this item of the plant, for with the extended trains of mills, or Searby shredders, multiple crushers and mills with juice-grooved rollers, nowadays met with, more attention is needed on the part of the mill maker in providing an efficient strainer; generally in present practice there is so much more "cush cush" or "bagucillo" passing from the grinding plant with the juice than was formerly the case.

An illustration is given (Fig. 120) of a roller scraper after Flower's U.S. patent. These should we think properly be fitted with spring tension and not be set rigid as shown in the figure referred to. For in the event of the roller service being injured by the passage of hard foreign matter, damage to the fixings of the scraper gear will result, unless the scraper is free to jump the excrescence until the trouble is noticed and the roller surface levelled. The springs should moreover be much stiffer than they are usually supplied.

Mr. Deerr's patented device, described and illustrated on page 232 for recording the movement of the top roller and thus giving a charted indication of the quantity of cane passing at any given moment, should prove very useful in keeping close control of the mill work, but the writer considers that the first mill top roller movement diagram should be within easy view of the attendant responsible for the feeding of the mills.

Of the other engineering chapters, that on the Defecation of the Cane Juice (XIV) contains much interesting new matter on the subject and should be read with profit.

A long chapter (XVIII) deals exhaustively with the evaporation of the water in the juice; and in it are described practically all well-known forms of evaporators, air-pumps, and condensers, and their heat utilization theories. The data supplied should be most useful to those who have new plant under consideration, or to those who are responsible for the results from existing installations. The bulk of the illustrations are new, as representing more recent design than was given in the 1911 edition.

A not less important chapter is that on the Steam Generating Plant and the use of Bagasse as Fuel, which is pregnant with useful information. The latest types of furnaces in use in various parts of the world for bagasse firing are illustrated and briefly described.

In conclusion, we may say the author is to be congratulated on his idea of adding the Patent Specification references. These should be of the greatest service to all those interested in the origin and development of the various devices illustrated and referred to in the body of this work.

A Presidential Decree published in Cuba establishes the standard for alcohol motor fuel as follows: The alcohol shall not be of a lower grade than 95 per cent. by volume; and to each 100 parts of the alcohol shall be added 0.5 part of formaldehyde; 3 parts of pyridine; 10 parts of sulphuric ether or of gasoline; and sufficient methyl violet to impart a distinct colour. To counteract corrosion by the acids formed on combustion, it has been found advisable to add enough ammonium hydroxide to the fuel to impart a neutral reaction as indicated by litmus paper.¹

¹ *South African Sugar Journal*, 1921, 8, No. 10, 981.

Publications Received.

Reitsuikerfabrieken op Java en hare Machinerieën. [Cane Sugar Factories in Java, and their Machinery.] By Q. A. D. Emmen. Second Edition. (Published by Q. A. D. Emmen, Embong Mawar 27, Sourabaya, Java.) 1921. Price: F 24.

A first edition of this work appeared in Java in 1918; and the fact that a second revised and enlarged issue of some 600 pages (of imp. 8vo. size) has followed so soon afterwards would indicate that it has met with ready appreciation in that country. It has been written for the use of the engineer engaged in the design, erection, and operation of the cane sugar factory in Java; and in general discusses the theory, construction, and working of the sugar machinery and accessories employed at each stage of manufacture. It is very fully illustrated with drawings, sketches, and photographs. In order to give an idea of the scope of this book, the following list is presented of its principal contents so far as these relate only to the first portion dealing with the transport and milling of the cane:—

Factory location, personnel, capacity, etc., with schemes showing the “lay-out” of various plants. Cane transport by ox-wagons, tractors, and railways, with sketches and photographs. Unloading. Cane carriers and elevators, with drawings of a number of installations, and their main parts, as couplings. Crushers and shredders of various types, and the calculation of the power required for these preparatory apparatus. Calculation of the capacity of the mills. Grooved rolls. Composition of roller metal. Settings. Housings of various makers. Trash turner constructions. Pressure regulation. Gearing. Steam consumption of various combinations.

Other sections treating of clarification, evaporation, boiling, curing, steam and electric power generating are in general dealt with in similar detail, and the book is therefore a comprehensive one. Although a good deal of the ground it covers has received treatment in English, yet it contains other useful information, relating particularly to the types of machinery in use to a greater or less extent at the present time in Java. It may be suggested to the author that a better subdivision of subject-matter, e.g., into chapters with a list of contents would be an improvement in the event of the publication of a future edition. Moreover, a number of the half-tone reproductions of photographs, for example those on pages 186-7, leave something to be desired.

Betriebskontrolle der Zuckerfabrikation. II Teil: Chemisch-technische Rechnungen. [Sugar Factory Management: Part II: Chemical-Technical Calculations.] By Dr. Oskar Wohryzek. (Albert Rathke, Magdeburg.) Second Edition. 1921. Price: M. 100.

Dr. WOHRZEK, author of that valuable work “Die Chemie der Zucker-industrie,” is writing a series of five books dealing with the management of the beet sugar factory and refinery, and these when completed will cover: laboratory work; chemical calculations; steam calculations; machinery work; and commercial management. We have before us the second volume of the series, that on the calculation of the results obtained in the laboratory, a first edition of which appeared during the war. It is divided into five parts, dealing successively with: general calculations; diffusion, slice-pressing and drying; carbonatation; evaporation and boiling; first massecuite working; massecuite and raw sugar yields; after-product and molasses working; refinery calculations; and various special yield calculations including those arising in “mixed factory” working. Altogether the author makes about 120 calculations of different kinds. In the first three parts, most of these are really of a very simple nature. It is when one arrives at the part dealing with evaporation and boiling that the worth of the book to the young sugar chemist is perceived. In this and in subsequent sections a number of calculations requiring to be made in modern beet factory control are shown in a way that certainly lacks nothing in regard to clearness. Yield calculations receive the full consideration that they deserve, and this part of the book is preceded by a short discussion of the development of the Hulla-Suchomel and Neumann formulæ,

Publications Received.

their relative value being explained. Refinery calculations here given concern such matters as the yield of affinate from the composition of the raw sugar and run-off syrups, the composition of the liquors resulting on melting certain raw sugars, and the amount of liquor necessary for the production of a strike of a certain volume. Lastly, there is some information on the calculation of the inventory of the raw sugar factory and the Continental refinery. There is no doubt that this book setting forth as it does a number of useful calculations in such a clear manner will be welcomed by the student of sugar factory control, particularly of course in the beet industry. It covers a wider range than Mittelstaedt's well-known "Betriebskontrolle," and is in fact intended to replace the last edition of that small work.

The Chemistry of Enzyme Actions. By K. George Falk. American Chemical Society Monograph Series. (Chemical Catalog Co., Inc., 1, Madison Ave., New York, U.S.A.) 1921. Price: \$2.50 net.

Enzymes are generally defined as catalysts produced by living matter; but, while an immense amount of work has been done with the purpose of throwing some light on the real nature of the catalytic effect, it would seem that we are yet far from a solution of the problem. It is being attacked at the present time in two directions: (1) the careful study of the kinetics of enzyme actions; and (2) their study as substances possessing definite chemical structures or configurations. In this monograph the progress which has been made in these two lines of investigations is set forth in a clear and systematic manner. In the discussion of the several theories put forward to account for catalytic re-actions, it is admitted that while much progress has been made in the way of systematizing the facts at present available, yet no completely satisfactory explanation has emerged from the accumulated evidence. It is held that the colloidal property is not necessarily connected with the enzyme property. In fact, the view is put forward that it should be possible to isolate enzymes in some way from biological material in the crystalloidal condition. However, for the elaboration of this and other views, the reader is referred to Mr. Falk's volume. It is a book which by reason of its lucid summary of our present knowledge of this elusive problem should be read by all interested in biochemistry.

Zeittafeln zur Geschichte der Organischen Chemie. [Chronological Table relating to Organic Chemistry.] Prof. Dr. Edmund O. von Lippmann. Pages, viii + 67. (Julius Springer, Berlin.) 1921. Price: M. 54 (in stiff paper covers).

Prof. VON LIPPMANN, who has published authoritative works on the history of the sugar industry, the chemistry of the sugars, and also the growth of alchemy in early times, has now made another useful contribution in the form of a chronological table relating to the development of organic chemistry. It extends from 1600 to 1890, and is provided with a subject and also with a name index. Against each date is given the name of the compound concerned, the subject of the event, and the reference to the original article. It is a compilation of considerable interest, since it provides, not only a record of important dates of observations and syntheses, but also the ready means of obtaining references to those classical papers which have built up the science of organic chemistry.

Feeding Blackstrap Molasses to Young Calves. R. C. Calloway. Louisiana Bulletin, No. 180. July, 1921. (Louisiana State University, Agricultural Experiment Station.)

Low grade cane molasses, it was found, may be fed with perfect safety to young calves, as soon as they begin to consume a little grain. Blackstrap is not laxative in combination with grain. It is nutritious, has a tonic effect, and makes the grain more palatable, causing the calves to consume more both of grain and of water.

Die Zuckerindustrie, Ihre Lage im Alten Österreich während des Weltkrieges. [The Sugar Industry, its Position in Old Austria during the World War.] Dr. Gustav Mikusch. (Verlag Wilhelm Frick, Ges. m. b. H., Vienna.) 1921.

Rules for conducting Performance Tests of Power Plant Apparatus. (American Society of Mechanical Engineers, 29, West 39th Street, New York, U.S.A.)

This is a small edition of the 1915 Power Test Codes, and embraces boilers; reciprocating steam engines; steam turbines; pumping machinery; compressors, blowers, and fans; complete steam power plants; locomotives; gas producers; gas and oil engines; and water-wheels. A committee of over 100 specialists is now revising this entire collection of test codes, including evaporating apparatus, particulars of which codes we hope later to give to our readers.

Correspondence.

MILL EXTRACTION FORMULÆ.

THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

SIR,—The expression given by me (in an article appearing in your Journal, in 1917)¹ for determining the extraction in a system of compound imbibition was, I have since found, incorrect. The correct solution, referred to unit quantity of sugar in the dry crushed bagasse, gives

$$\text{Extraction} = \frac{r}{r + (1 - r)^n}$$

where r is the constant factor of recovery at each unit of n mills in series.

The error was pointed out to me by a colleague, Mr. LEWIS WACHENBERG, who supplied me with a happy and simple solution of the problem. This appears on page 235 of my newly-published revised edition of "Cane Sugar." All points raised by Mr. PARR in your October issue² referring to the use of the expression as offered are well taken, but on one or two minor points a difference of opinion may be raised. For instance, he refers to "the somewhat unusual assumption that the bagasse from each and every mill of a train has the same fibre content." I was considering a plant of not less than a crusher and four mills, of which the crusher and first two mills would be regarded as the dry crushing unit, and the later ones as wet crushing units. In such a combination the fibre content of the bagasse as it leaves the dry crushing unit and each of the later ones should be sensibly constant, and under such conditions a fibre content of 50 per cent. in the bagasse leaving the second and subsequent mills should be (and in many cases is) obtained. On the other hand, if a single mill is regarded as the dry crushing unit, imbibition will commence on an imperfectly prepared material and it will not be possible, as Mr. PARR points out, to accept a constant for the value of r .

As regards the application of the expression (of course in its correct form) to the diffusion battery, I do not see that I am in error. The demonstration already referred to above on page 235 of "Cane Sugar" is equally applicable to a diffusion battery, only substituting "cell" for "mill" and "sliced cane" for "bagasse."

In one particular, however, Mr. PARR does not do me justice. I did not wish to infer that his solution was incomplete, or to draw any comparison between his and my solutions. On the contrary, I was at pains to point out the greater convenience of his methods compared with those of mine to which he had referred in his original contribution on this subject. I will, therefore, regard Mr. Parr's present article not as a reply to me but as a very valuable contribution to the theory and practice of cane milling.

NOËL DEER.

¹ I.S.J., 1917, 401.

² 1921, 562.

Brevities.

Dr. P. A. VAN DER BIJL, who recently published two valuable contributions on the deterioration of raw sugar,¹ has been appointed Professor in Plant Pathology and Mycology at the University of Stellenbosch, Union of South Africa.

Kenya is a British colony that promises to develop the cane sugar industry. An Australian capitalist has recently floated a company with a capital of £400,000 to start a sugar factory near the Victoria Nyanza,² while a big South African sugar planter has secured options on properties with a view to growing sugar cane and erecting a factory.

The Mauritius sugar crop will probably not reach 200,000 tons (as compared with 600,000 tons last season). The shortage is due to a cyclone last March, followed by unfavourable weather. There is also a shortage of labour to contend with. Opening sales of this season's sugar by the Mauritius Sugar Syndicate have averaged about Rs. 14-50 per 60 kilos. to the seller.

The *Sole* of October 6th, 1921, states that the production of sugar in Italy this year is calculated to be over 2,000,000 quintals, against little more than 1,000,000 produced last year. The yearly consumption of sugar in Italy is estimated at 2,200,000 quintals, so that, with the stock left over from last year, very little will have to be purchased abroad, compared with the 1,000,000 quintals of foreign sugar imported last year.

China, says a Department of Overseas Trade Report, is the principal market for Japan's refined sugar, but in 1920 large shipments were also made to South Africa. The business has been suffering from a severe slump, and many of the Formosan mills have been hard hit. An interesting feature of last year's trade was a very large and profitable contract in Java sugar with the United Kingdom made by one of the leading Japanese firms.

In Australia the Hurrey cane cutting machine is said to have given encouraging results during recent trials. In principle it resembles the "Victor" machine,³ carrying the cane upwards and backwards to a topping apparatus. It is claimed that this machine will be able to cut four acres per day, the cost being about 2s. 6d. per ton of cane, as compared with 1s. 6d. for the "Victor" under the conditions of labour prevailing in South Africa.⁴

According to Messrs. WILLETT & GRAY, if the German Reichstag confirms the proposed increase in the consumption tax on sugars in Germany, the matter of collecting an import sugar duty—temporarily annulled during the war—will probably be taken up again; at the present moment the import into and export from Germany of sugar is prohibited, but should the prohibition be removed, well-informed opinion believes that the import duty would be fixed at 40 marks, gold, per 100 kilos, as a minimum.

Commenting upon Bird's process of adding the lime necessary for clarification to the last mill juices, these being returned for maceration to the first mill, a writer in *Java comments*⁵ that this method of working is undesirable so far as conditions in his country are concerned for the following two reasons:—(1) By bringing an alkaline juice in contact with the first mill bagasse, the danger of dissolving rind colouring matters is incurred, the neutral reaction of the mixed juice as it leaves the milling station being incapable of precipitating these substances completely, if at all. (2) Bagasse contaminated in this way with lime or lime salts may cause the formation of clinker.⁶ Moreover, it is remarked, the introduction of this procedure would complicate matters in the application of the system of chemical control adopted by factories in Java.

¹ *I.S.J.*, 1921, 330, 482, and 504.

² *I.S.J.*, 1921, 524.

³ *I.S.J.*, 1920, 411. ⁴ *South African Sugar Journal*, 1921, 5, No. 10, 945.

⁵ *Archief*, 1921, 29, No. 35, 1195-1196.

⁶ This objection at least would not appear to hold, as the additional amount of ash that would thus be added to the bagasse would be inappreciably small. It has been proved that in factories using the Thomas & Petree process, in which all the filter-press scums are returned to the bagasse, the nature of the ash remains unaffected, and clinkering is unknown—*Ed., I.S.J.*

Review of Current Technical Literature.¹

SOLUBILITY OF CALCIUM SULPHATE IN CARBONATED BEET JUICES OF VARYING ALKALINITY. *Vlad. Stanek. Listy cukrovarnické, 1919-20, No. 40, 289; Zvtsch. Zuckervnd. czechoslovak. Republik, 1921, 45, No. 1, 1-3.*

It has already been shown by Mr. STANEK² that as the result of the carbonation of beet juice there occurs a remarkably complete elimination of the calcium sulphate originally present, and that far more is present in the carbonation scums than one would expect to find from the solubility tables of JAKOBSTHAL³ and BRUNN⁴, both of which investigators, however, worked with pure solutions of sucrose, and operated in the cold. In order to enter more closely into the question, a series of solubility determinations were carried out under actual factory conditions with first and second carbonation juices, to which varying amounts of lime had been added, the temperature being 85°C., that generally possessed by the liquid as it issues from the filter-presses. It was concluded that the solubility of CaSO_4 in beet juices at the temperature stated increases as the alkalinity decreases, being, e.g., 0.19 grm. in 100 c.c. at an alkalinity of 0.997 grm. of CaO per 100 c.c., but 0.26 grm. when the alkalinity has been lowered to 0.003 grm., which values are higher than those found by the two chemists mentioned above. It is thus again shown that such is the solubility of CaSO_4 in beet juice under the conditions obtaining during clarification that none should pass into the carbonation scums, and all should remain in solution if the question is viewed solely in the light of solubility. It therefore appears to follow that the separation of the CaSO_4 is due either to its entrainment or adsorption by the precipitate of calcium carbonate during carbonation, or else to the formation of double compounds of calcium sulphate and calcium carbonate (or possibly basic carbonate). At any rate, it is certain that its separation is not due to the diminution of the alkalinity during carbonation, an explanation which hitherto appears to have been thought feasible by some of those who have taken up the study of this question.

STANDARDIZATION OF METHODS OF TESTING THE CAPACITY OF EVAPORATORS. *Anon. Mechanical Engineering, 1921, 43, No. 3, 184-187.*

Some years ago the American Society of Mechanical Engineers appointed a Power Test Committee, the purpose of which was to draw up specifications of standard methods for testing different classes of apparatus comprised in power plant equipment. In 1916 the first "codes" were published, and in 1918 the Committee was reorganized to revise and enlarge the specifications already elaborated. This year the test code for evaporating apparatus, including vacuum multiple effects plant and vacuum pans, was published, the members of the Committee engaged in this work being Messrs. E. N. TRUMP, B. N. RUMP, L. C. ROGERS (Solvay Process Co.), H. L. PARK (Columbia University), and E. A. NEWHALL (manufacturer of evaporator plant). The report is a very complete one, a code being drawn up covering a very large number of items, the principal of which may be grouped as follows:—Measurements, instruments and apparatus; preparations; operation conditions; starting and stopping; duration; records; and the calculation of the results.

BOILER TESTS CARRIED OUT IN THE PHILIPPINE ISLANDS, USING BAGASSE AS FUEL. *D. M. Semple. Sugar News, 1921, 2, No. 5, 159-161.*

A test was made in the Philippines with (a) an installation of five 7 ft. \times 20 ft. horizontal return tube boilers each rated at 250 H.P.; and (b) a new Stirling boiler rated at 439 H.P., the data relating to the two sets being as follows. Proportion of grate area to heating surface, (a) 1: 80.7, (b) 1: 126.7; furnace volumes, (a) 200.7, (b) 260.7; and the furnace conditions were the same in both, step ladder grates of 34.64 sq. ft. grate area carrying a draught of 0.5 in. being used. Results showed that the evaporation of water in lbs. per sq. ft. of grate area per hour was (a) 266.3, (b) 283.8; and the lbs. of water

¹ This Review is copyright, and no part of it may be reproduced without permission.—Editor, I.S.J.)

² I.S.J., 1920, 347. ³ *Deut. Zuckertnd.*, 1868, 662. ⁴ *Centr. Zuckertnd.*, 1907, 396.

Review of Current Technical Literature.

per sq. ft. heating surface per hour (a) 3.3, (b) 2.24. The h.r.t. boilers were working almost to the normal rated capacity of 3.45 lbs. of water per sq. ft. of heating surface per hour, whilst the Stirling boiler was giving nearly 68 per cent. of the capacity of the others. On the other hand, the new boiler was producing an almost seven per cent. better result in evaporation per sq. ft. of grate area. It was concluded that the furnace under the Stirling was altogether too small, it being impossible to burn the required amount of bagasse on the grates. Generally the proportion of grate area to heating surface is now 1 : 10; but if this were made 1 : 8, and the volumetric capacity of the furnace increased in like proportion, it should be possible to operate the boilers under an overload with very slight loss in efficiency and consequent need of more fuel (of which there is usually an excess in the Philippine Islands). Regarding the proportion of grate area to combustion space, in the Philippines this is generally from 5 : 1 to 7 : 1; and there would be no danger in increasing the volume considerably where better combustion and steaming is required.

DARK COLOURED SULPHATE OF AMMONIA *A. E. Berkhout. Archief, 1921, 29, 147-153.*

A parcel of S. A. bought during the war had a dirty purplish colour; and the question arose whether it could safely be used as fertilizer. Its total nitrogen content was normal, though it contained 0.7 per cent. of substances insoluble in water, whereas 0.2 per cent. is the usual amount of this impurity. Further chemical examination showed the coloured impurities to be particles of iron oxide, iron sulphide, and tarry matter. The sample also contained a comparatively high amount of pyridine; but the high nitrogen content of this impure S. A. was due (it is said), not so much to the nitrogen of the pyridine bases, but rather to the low content of sulphuric acid. It was decided that in spite of its suspiciously dark colour, the sulphate of ammonia could safely be used for the manuring of plants. Pyridine easily decomposes in the soil; while the other impurities in the amounts mentioned are considered not likely to do any harm.

DETERMINATION OF TRACES OF REDUCING SUGARS, USING PHOSPHOMOLYBDIC ACID.

G. Fontès and L. Thivolle. Bull. Soc. Chim. Biol., 1921, 3, 226-237.

Two c.c. of the solution, containing 0.5-1.0 mgrm. of reducing sugars, are boiled for six minutes with 1 c.c. of Fehling's solution; five drops of a saturated solution of magnesium sulphate, and four drops of a saturated solution of sodium carbonate, are quickly added, and the mixture again boiled for one minute. After separating the cuprous oxide by centrifuging, the precipitate is dissolved in 5 c.c. of phosphomolybdic reagent,¹ and the blue coloured liquid so obtained titrated with a 0.008 per cent. solution of potassium permanganate until the colour is discharged. At the same time a solution containing a known amount of dextrose is treated under exactly comparable conditions, and the result thus calculated.²

COLLOIDAL EFFECT OF THE SULPHITATION PROCESS COMPARED WITH THAT RESULTING FROM TREATMENT WITH Kieselguhr and DECOLORIZING CARBON. *Jos. F. Brewster and Wm G. Raines. Journal of Industrial and Engineering Chemistry, 1921, 13 No. 10, 921-923.*

Clarification, whether by the defecation, sulphitation, or carbonatation processes, has, as its effect, the elimination (more or less complete) of the colloidal impurities present originally in the raw juice. ZERBAN³ a short time ago proposed a particularly efficient method of eliminating the colloids from raw juice, according to which the raw juice was treated with kieselguhr, filtered, treated with decolorizing carbon, and again filtered. MESSRS. BREWSTER and RAINES in this paper describe experiments showing the comparative value of the (1) sulphitation and (2) the kieselguhr and carbon processes, in respect of

¹ This is prepared by boiling 40 grms. of ammonium molybdate with 60 c.c. of sodium hydroxide (1.38 sp. gr.) and 100 c.c. of water until ammonia is no longer evolved. After cooling, 200 c.c. of water and 200 c.c. of phosphoric acid (1.38 sp. gr.) are added, and the solution again boiled for 15 minutes, the solution when cold being diluted to one litre.

² The method described above is a modification of that of FORTIN and WU, the determination of the cupous oxide being made volumetrically, instead of colorimetrically.

³ *I.S.J.*, 1920, 332, 643, 699.

colloid elimination as measured by the amount of non-dialysable solids remaining. In the first series of tests, about 3000 lbs. of raw juice was sulphited, limed back, and filtered, a sample of 200 c.c. being then dialysed in a colloidal bag in running water, and the solids and ash content of the liquid remaining (the dialysate) being ascertained. In the second series, 3000 lbs. of raw juice were treated with 0.66 per cent. of kieselguhr, heated just to boiling point, filtered, treated with 1 per cent. of decolorizing carbon, heated to boiling point, and again filtered, the resulting clear liquid being examined for its total colloid content as before. Their results are interesting, and leave no doubt as to the superiority of the kieselguhr and carbon process, though its economical aspect is not considered. Thus, the total colloid solids of a raw juice were 407.1 grms. per 100 c.c. before treatment, but were reduced to 70.3 and 51.1 after sulphiting and liming respectively; while with a juice originally having the same colloid content they were reduced to 45.8 and 18.1 grms. after treating with kieselguhr and carbon. Therefore, after the sulphitation process the colloids remaining were 51.5, but after the kieselguhr and carbon treatment only 18.8 grms. per 100 c.c. were present, showing a marked advantage from the point of view considered in favour of Zerban's method of working.

EXAMINATION OF KIESELGUHR IN RESPECT OF ITS SUITABILITY FOR THE FILTRATION OF SUGAR JUICES AND SYRUPS. *H. S. Paine and C. F. Walton, Jr. (Paper read before the Sugar Section of the American Chemical Society, 1921.) Science, 1921, 53, 266.*

Results are reported of a comparative study of various types of kieselguhr for the purpose of correlating physical properties and clarifying efficiency as a possible means of determining their relative market values. These experiments included a microscopic examination of the various samples, tests of comparative rates of filtration, sedimentation, fineness by sieving, solubility in dilute acids and alkali, and the quantitative determination by analysis of the colloids present in the juice before and after treatment with the kieselguhr. So far the results indicate that provided a sufficient amount of the diatomaceous earth be used to afford the minimum adsorbing surface required for the colloids present, there is little if any difference when equal weights are used, even though the different grades differ considerably in physical properties. As has been proved by the work of ZERBAN,¹ heating and filtration with kieselguhr remove all colloids having such a dispersion that a turbidity is visible to the eye; but the subsequent use of decolorizing carbon eliminates colloids of such dimensions as impart no visible dimness to the liquid.

PRECIPITATION OF AMINO-ACIDS AND ACID AMIDES DURING THE CLARIFICATION OF BEET JUICES BY CARBONATATION. *Vlad. Stanek. Listy cukrovarnické, 1920-21, Nos. 37 and 38; Zeitsch. Zuckerind. cecho. Republik, 1921, 45, No. 5, 45-48.*

As the laboratory method employed by SIEGFRIED² for the separation of the amino-acids and amino-acid amides resembles in general principle the process of carbonatation as applied in the beet sugar factory, it seemed of interest to ascertain to what extent these compounds might be thrown down in practice. Solutions containing 0.1 per cent. of the amino-acid compound, and 15 per cent. of sugar, were treated with 1.8 per cent. of calcium oxide as milk, heated to 85°C., allowed to stand at this temperature for 15 mins., and saturated with carbon dioxide to an alkalinity of about 0.01 per cent. CaO, the precipitate being finally dried and its nitrogen content determined (by Kjeldahl's process, following a procedure recently prescribed³). It was thus found that the amounts precipitated compared with those originally present were with aspartic acid 62.3; asparagin, 15.6; glutamic acid, 40.5; and leucin, 6.0 per cent. In other experiments it was demonstrated that the greater the amount of milk-of-lime added, the more amino-acid was precipitated, so that when 4.0 per cent. of CaO was employed, nearly 80 per cent. of aspartic acid was found in the precipitate. Since amino-acids form soluble salts with calcium, it follows that if in practice a good proportion of milk has been added, and if it remains in contact with the juice for a sufficiently long time, the calcium content of the filtered juice will be

¹ *I S.J.*, 1920, 332, 643, 689.

² *Zeitsch. f. physiol. Chem.*, 1921, 260. ³ *Zeitsch. Zuckerind. cecho. Republik*, 1920-21, 323.

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low, provided of course that saturation be correctly conducted. Other points that were established by Mr. STANEK were that only a slight precipitation of amino-acids occurs when the juices are over-carbonated; that quite an appreciable precipitation occurs in the second carbonatation, especially when more lime has been added; and lastly that (under the conditions of the second saturation, at any rate) a much better precipitation of amino-acids takes place when SO_2 rather than CO_2 is used,¹ which last result is in agreement with the observations of BRUESLER² that when sodium sulphite is added for the removal of the lime salts from the juice (according to Rümpler's process)³ a certain amount of nitrogenous substances pass into the filter-press scums.

DETERMINATION OF THE DRY SUBSTANCE IN JUICES, SYRUPS, MOLASSES, ETC., USING SPENCER'S ELECTRIC OVEN. *George P. Meade. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 10, 924-925.*

Originally Spencer's electric oven⁴ could only be used for the determination of the dry substance of materials that are fibrous or granular, as bagasse or raw sugar; but Mr. MEADE here shows that by absorbing a solution of any sugar product with asbestos the great advantage which this apparatus possesses in respect of rapid desiccation may still be utilized for liquids. Fluffy asbestos (freshly ignited) is loosely packed into one of the capsules, which is weighed; about 4 c.c. of the liquid are run drop by drop upon the asbestos, and the capsules again weighed; then the desiccation is carried out at 110°C . in the way already described, a strong current of air being drawn through the oven. It was found that a practically constant weight was reached in 10 mins. in the case of weak solutions, such as juice (containing about 14 per cent. of solids), and in 20 mins. in that of heavier and more viscous solutions of molasses, syrup, or honey (diluted 1:1). In the case of these heavier products, heating should not be continued for longer than 20 mins., and heating to exactly constant weight should not be attempted. When holding to the times stated a very close agreement between solids taken and found was attained, reaching 1 in 300 in the case of solutions of raw and refined sugars. Even a solution containing invert sugar and sodium chloride gave a very close agreement with the actual solids after 20 mins. heating, indicating that no destruction of levulose had occurred during that period.

DETERMINATION OF THE REDUCING SUGARS IN CANE JUICES WHICH HAVE BEEN TREATED BY MEANS OF BASIC LEAD ACETATE. *Joseph B. Harris. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 10, 925-926.*

Horne's dry basic lead acetate⁵ has been found the most effective preservative for the composite samples of juice (adding it at the rate of 20 grms. per litre); but it is well known that, compared with the original liquid, juice so treated contains less reducing sugars, when these are determined by Fehling's solution after the excess of lead salt remaining in solution in the juice has been eliminated by means of a suitable de-leading reagent, such as sodium oxalate, carbonate or chloride. Experiments are here described proving this point. Thus, in a juice the reducing sugars were originally found to be 1.04 per cent., but only 0.99 after the addition of dry basic lead acetate and sodium oxalate to precipitate the lead remaining in solution. However, entirely satisfactory results were obtained by the use of a suitable acid for de-leading if it were added to the liquid without filtering off the precipitate produced on the addition of the dry basic lead acetate. Oxalic acid gave the best results; but phosphoric acid was less dependable, the results varying somewhat for some reason or other. Acetic acid appears incapable of decomposing the compound formed by the lead with the reducing sugars unless used in an inconveniently large excess. It is emphasized that it is useless to employ the oxalic acid as a de-leading reagent *after* filtering off the lead precipitate. It must be added to the liquid containing the lead precipitate to be effective.

¹ In many factories, particularly in France, it is preferred to operate the second or third saturation with SO_2 , as in Weisberg's "sulpho-carbonatation" process.—Ed., *I.S.J.*

² *Deut. Zuckerind.*, 1897, 676.

³ *Ibid.*, 22, 679; 24, 439.

⁴ *I.S.J.*, 1921, 333.

⁵ *I.S.J.*, 1919, 406.

METHOD OF USING "NORIT" DECOLORIZING CARBON AT TAI-KOO REFINERY, HONG-KONG. *D. Templeton. Facts about Sugar, 1921, 13, No. 14, 270.*

A refinery of 750 tons daily capacity, in which the "Norit" system will be solely used, is being erected at Tai-Koo, Hong-Kong, to take the place of the bonechar house, which is being dismantled. After affining in centrifugals to a purity of 99°, the raw sugar is melted to a liquor having a density of about 60° Brix (hot); and this liquor is submitted to two treatments with "Norit": (1) to remove the gums, pectins, and the like, and (2) to adsorb the colouring matter. In the first or "de-gumming" treatment, the melt is treated at about 95°C. with 5-6 per cent. of "Norit" in tanks provided with stirrers and coils, filtered through plate-and-frame presses, and the clear liquor (free from particles of carbon¹) sent to the storage tanks. This used "Norit" may be used again without regeneration on a fresh batch of liquor, and yet again, its application being repeated as long as the melt filters with sufficient rapidity through the plate-and-frame presses, attention being paid rather to ease of filtration than to degree of decolorization. It may in fact some times be used 10 times over; but when it is exhausted, the cakes are washed with water, boiled with 2 per cent. hydrochloric acid for an hour or more, the mixture largely diluted with water, and filtered in plate-and-frame presses (preferably of wood), giving a final wash with a $\frac{1}{4}$ per cent. solution of sodium carbonate. "Norit" thus regenerated may be applied to fresh batches of melt repeatedly as often as six times, after which another acid revivification follows. Depending upon the quality of the raw sugar, the "Norit" may be used for this first treatment 30 to 70 times with the intermediate acid treatments; but after this it is necessary to reburn it. It is then again put into process, and used again and again.

Regarding the second or decolorizing treatment, this also is effected at 95°C. by the use of 5-6 per cent. of "Norit," which, as in the pre-filtration, is used over again as long as it decolorizes sufficiently. Then it is revived with hydrochloric acid as already described, washed with water in a press, and reburned. It is not used again without reburning, as in the first treatment; and when the "Norit" used in this second treatment is so far exhausted that reburning does not sufficiently restore its decolorizing power, it is used for the first treatment. This system of applying "Norit" has proved very economical, and has shown that the "Norit" can be reburned 100 times (the loss each time being about 1 per cent.). Only a small quantity need be reburned daily, about 1-2 per cent. of the weight of sugar melted. Another advantage of this system compared with the ordinary application is that the melt is better decolorized, notwithstanding the small amount of "Norit" reburned, so that the sugar produced is of a superior quality, equalling the best bonechar refined. Moreover, when using bonechar the loss of solids (at Tai-koo) has been 1 per cent. or more; but with "Norit" it should be found to be only 0.25 per cent. Fuel bills are greatly reduced, the saving amounting to 30 per cent. In regard to the initial cost of plant, the equipment for "Norit" filtration and decolorization is only 20 per cent. of that necessary for bag filtration and bonechar decolorization. Lastly, it is added that the washings resulting from the affining of the raw sugar can be treated with 10-15 per cent. of "Norit" to obtain a good filtration. Less re-boiling is required, and the resulting final molasses is of better quality than ordinarily and brings a better price as "barrel syrup."

EFFECT OF THE VARIATION OF THE H-ION CONCENTRATION* IN THE USE OF DECOLORIZING CARBON. *Jos. F. Brewster and Wm. G. Raines, Jr. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 11, 1043-1044.*

WIJNBERG² has pointed out that when using "Norit" a better decolorization may be obtained if the juice possesses a slight acidity, one equivalent to 0.01 N being recommended. On the other hand, at an alkalinity of 0.2-0.33 N the decolorization was observed to sink nearly to zero. In seeking an explanation of these two effects, one may be

¹ The General Norit Co. recommend as a precaution a second filtration through a small gravity filter or a filter-press, lined with cloth only, or better with cloth coated with a thin layer of kieselsguhr.

² *I.S.J.*, 1915, 70.

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reminded that PERRIN¹ has stated that the size of the particles of a colloid solution is a function of the reaction of a medium; but whatever may be the real reason the fact remains that the effect of decolorizing carbon in adsorbing the colours and pectins of sugar products is influenced by the reaction of the medium, or in other words by the concentration of hydrogen or hydroxyl ions in the medium. This question was examined more closely by the authors at the Louisiana Sugar Experiment Station. It was found that the H-ion concentration of normal cane juice ranged from pH = 4.8 to pH = 5.8; but that these values seemed to have little relation to the titratable acidity, as usually determined, and this is explained on the ground that the acids of cane juice are organic acids which are little dissociated, so that their slight increase or decrease would have little effect on the pH value. A series of experiments was carried out in which the decolorization was observed when the H-ion concentration was varied within the limits of pH = 4 to pH = 8; and the figures obtained clearly demonstrated that with the increase of the H-ion concentration there was an increase in the adsorption effect, both with acetic and phosphoric acids. However, in view of the amount of inversion that can be brought about even at an acidity as low as pH = 5 (about that of normal juice), it would appear doubtful whether much advantage could be gained in practice by acidification unless conditions were carefully controlled. Good results are said to have been obtained by heating the juice and carbon to boiling point, adding phosphoric acid to an acidity of pH = 4, allowing a short time for action, and neutralizing back with milk-of-lime, taking care not to obtain an alkaline reaction. It was found safe to stop the addition of the milk-of-lime at about pH = 6.5. By this procedure as good a decolorization could be obtained as by carrying through the entire procedure at pH = 4.

COMPARISON OF THE CALCIUM, BARIUM, AND STRONTIUM PROCESSES FOR THE EXTRACTION OF THE SUGAR REMAINING IN BEET MOLASSES. *Mich. Potvliet.*² *Journal of Industrial and Engineering Chemistry*, 1921, 13, No. 11, 1041-1042.

In the lime process, the very finely powdered calcium oxide was mixed in special "coolers" with the molasses diluted to 12° Brix, adding small portions at a time, and keeping the temperature at about 10°C., the saccharate formed being washed with lime water, and the CaO used being 110 per cent. of the polarization. In the barium process, the undiluted molasses was treated with a hot concentrated solution of barium hydroxide at 76° Bé. at 85°C., and the mixture kept at 65°C., the saccharate formed being washed with 2 per cent. barium hydroxide solution, and the BaO being about 68 per cent. of the polarization. In the strontium process, the slaked oxide was added to the undiluted molasses at boiling point, ebullition continued, and the saccharate filtered through presses, the SrO used being 100 per cent. of the polarization. Then out of 48.5 per cent. of sugar originally present in the molasses used, the yields and losses were as follows:—

PROCESS.	As Granulated Sugar. Per cent.	Sugar in Molasses. Per cent.	Sugar in Mother Liquor. Per cent.
Calcium	35.45	8.05	5.00
Barium	43.97	2.91	1.62
Strontium	43.18	4.32	1.00

It was observed after the decomposition of the saccharate by carbon dioxide that the "juices" resulting on filtration were lightest in the case of the strontium process, being pale straw in colour, and darkest with the Steffen process. In the barium process, the raffinose was partly eliminated, which gives it a great advantage over the other two methods from the point of view of the removal of this trisaccharide. Apart from the cost of the oxides, the strontium process is more economical than the Steffen. It is concluded that if strontium and barium oxides could be made more cheaply than at present, they would displace calcium oxide for the "desugarization" of beet molasses.

J. P. O.

¹ *J. chim. phys.*, 1904-5. See also MAYER, SCHARFFER and TERROINE, *Comptes rendus*, 1907, 145, 918.

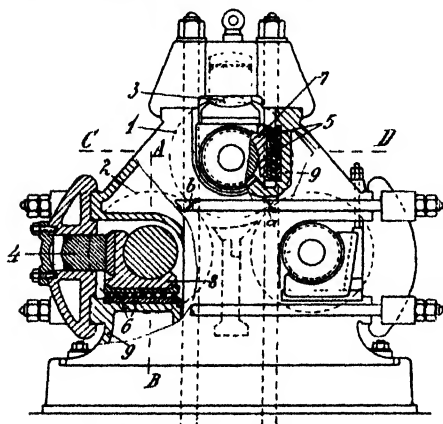
² Dominion Sugar Co., Chatham, Ontario, Canada.

Review of Recent Patents.¹

UNITED KINGDOM.

CANE MILL. *Frederik J. de Bruin*, of Rotterdam, Holland. 149,289 (21,403).
July 15th, 1920; convention date (Netherlands), July 15th, 1919.

The complete specification of this patent (an abstract of which has already been published in these columns²) has now been issued. Its object is to eliminate the disadvantages of the pressure irregularities appearing in common mills, and of those of the movable dumb-turner in the mill with hydraulic arrangements on the two-side rollers. It consists substantially in the application of hydraulic pressure both on the top and on the



back roller of the mill, by which arrangement the pressure in each of the two openings of the mill will be always in a fixed relation to the hydraulic load acting on the top and on the back roller, respectively, even in case of most negligent charging. As in a mill constructed according to this invention, the components of the hydraulic pressure in the direction of the connecting lines between top and side rollers are always in accordance to the required pressure on the cane in each of the two mill openings, the top and back rollers always being mobile, each fluctuation in the charging of the mill with sugar cane will cause always a corresponding alteration in the position of the rollers.

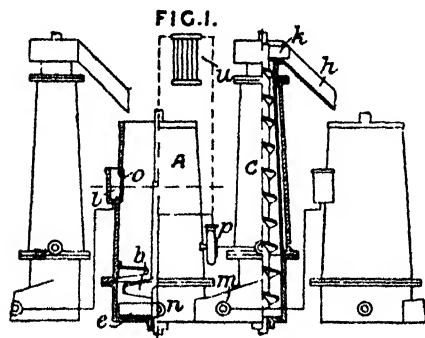
Referring to the drawing, and presuming a surplus of cane to be entering into the front opening *a*, the top roller *1* will be lifted, thus causing enlargement of the rear opening *b* and consequently a corresponding reduction of the pressure therein, just as in a mill of common construction. This pressure reduction in the rear opening *b* of the present mill, however, will cause immediately a corresponding reduction of the size of the rear opening, thus the amount of pressure on the cane in the rear opening remains the same, viz., exactly in relation to the amount of the hydraulic pressure exerted on the back roller *2*. On the other hand, if the quantity of cane entering the front opening *a* is decreased, the top roller *1* will descend and the consequent increase of rear opening pressure will cause the starting back of the back roller *2*. The frictional resistance, arising if the direction of movement of the hydraulic rams *3* and *4* acting on the top roller and the back roller respectively does not coincide with the connecting lines between top and side rollers, may be diminished by suitable means, for instance by providing balls *5* and *6*, or rollers, between the roller trunnions *7*, *8*, and the mill housings *9*. The hydraulic rams *3* and *4* can be applied in different directions. The top roller *1* can be loaded either vertically (preferably when the invention is applied to existing mills), or in any oblique direction, for example at an angle of 90° to the connecting line between the top and back rollers, which would have the advantage that lifting of the top roller *1* cannot influence the size of the back opening *b*, and the movement of the back roller *2* cannot cause any alteration in the position of the top roller *1*. The hydraulic rams *4* on the back roller *2* can be placed so as to act in a horizontal direction (preferably if the invention be applied to existing mills), or in any other direction, for instance in the direction of the back pressure, by which arrangement the vertical pressure of the back roller trunnions *8* on the mill housings is eliminated.

¹ Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

² *I.S.J.*, 1920, 713.

EXTRACTION OF JUICE FROM THE BEET BY DIFFUSION. *A. Rak, of Prague.* 166,527 (18,148). July 5th, 1921; convention date, July 13th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Apparatus for the extraction of juice from the beet is described. It comprises an open ended vertical diffusion chamber *A* and screw straining device *C* connected at the



bottom by a horizontal conduit. The beet slices are fed to the top of the chamber *A* and discharged from the bottom by rotary blades *b*, *c* and other blades co-acting therewith through the conduit to the press *C*, from the top of which they are discharged by blades *k* to a shoot *h*. Fresh liquid enters the press at *m*, and the expressed liquid is passed by a pump *p*, through a heater *u* if necessary, to the chamber *A*, which it enters at *n*. Liquid overflows from the chamber *A* through a strainer *o* and gutter *l*. A

number of such units may be arranged in a battery, the liquid and beetroot passing through them in counter-current. The first two units may be arranged in parallel and the remainder in series.

CONTINUOUS CLARIFYING CENTRIFUGAL. *G. Mumford, of Chorlton-on-Medlock, Manchester.* 164,410 (2637). April 22nd, 1920.

Machines for separating solids from liquids have an axial inlet, tubular arms radiating therefrom to a conical separation chamber, and solid-discharging outlets on the outer periphery of the chamber. After clarification the liquid is discharged, either from outlets on the inner periphery of the separating chamber, or by way of radial tubes and an axial outlet; while the solids are removed from the wall of the outer casing by scrapers, which are moved by a chain or circular rack driven by pinions. Several forms of separating drum are described.

PREPARATION OF DECOLORIZING CARBON IN GRANULAR FORM. *H. E. Brown, of Kingson, New York, U.S.A.* 167,740 (11,580). April 21st, 1921; convention date, August 12th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Carbon for use as bleaching or filtering material, in granular form and capable of being pressed into a compact granular mass, is prepared in such manner that each granule consists of a dense hard carbon framework carrying a substantial amount of soft spongy carbon. This result is stated to be obtained by briquetting a mixture of relatively soft carbon and hydrocarbon and then crushing or grinding the briquettes. In an example, 6 parts of lampblack, 3 parts of by-product coke-oven pitch, and 1 part of by-product coke-oven light oil are mixed with water, pumped through a filter-press, and dried until it contains only from 10 to 15 per cent. of moisture. This material is briquetted, and the briquettes are broken up into granules and retorted at a temperature sufficiently high to crack and drive off the bulk of the volatile constituents. Finally, the mass is broken up and sieved.

EVAPORATORS. *F. Merz, of Vercelli, Italy.* 150,785; 150,786; 166,004 June 4th, 1919; May 5th, 1920.

Liquids to be concentrated, such as sugar juices and syrups, are distributed over one surface of a heat-conducting material or of a thin tube or plate, a liquid that absorbs the evolved vapours is distributed over the other surface, and a current of air or gas is circulated from one surface to the other. The latent heat evolved on absorption of the vapour is thus transferred to the liquid undergoing evaporation.

MOTOR FUEL CONTAINING ALCOHOL AND ETHER. *A. T. Wilford and A. A. M. Durrant*, of Dulwich, London. 167,831 (13,173). May 12th, 1920.

A motor spirit comprises alcohol having in solution a readily dissociable salt of a nitrogenous base and an oxyacid of nitrogen that on explosion of the fuel yields only gaseous products of decomposition. Salts specified are ammonium nitrate, hydroxylamine nitrate, hydroxylamine nitrite, and hydrazine mononitrate. Two or more salts may be used, and there may be present ether, acetone, benzol, or other liquid fuels. In an example, 1-2 per cent. of ammonium nitrate is dissolved in alcohol, aqueous alcohol, or denatured alcohol. The alcohol may be denatured by 2 per cent. of wood naphtha or methyl alcohol, 5 per cent. of benzol, and a trace of methyl violet or other dye.

MANUFACTURE OF DEXTROSE (GLUCOSE) FROM MATERIALS CONTAINING CELLULOSE. *A. Classen*, of Aachen, Germany. 164,329 (15,249). June 1st, 1921; convention date, June 4th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

In the process described in the parent specification¹ for obtaining dextrose (glucose) from wood and other cellulose-containing substances, a mixture of hydrochloric and sulphuric acids is now used as the chief acid, the hydrochloric acid being preferably the main constituent. The catalytic agents are those described in the parent specification, and metals and metallic oxides, such as iron oxide, manganese oxide and chromium oxide, may be added as "protective substances."

THRASHING LIQUIDS (IN CONFECTIONERY MANUFACTURE).² *F. G. Fryer and Rowntree & Co., Ltd.*, of York. 165,844 (18,516). July 25th, 1919.

Relates to machines for beating or thrashing liquids, preferably in the presence of air, and more particularly for treating mixtures of cocoa, liquor, sugar and other ingredients in the manufacture of chocolate fondants. The machine is of the type in which a high-speed rotor provided with blades, pins, projections, or the like works within a stator, the material being passed through the clearance-space between the rotor and the stator.

EXTRACTION OF GLYCERIN FROM DISTILLERY SLOPS (VINASSE OR SPENT WASH). *Barbet et Fils et Cie.*, of Paris. 168,835 (13,482). September 19th, 1917; convention date, September 29th, 1916; *void*; but published under Section 91 of the Act.

In a process for treating waste liquors of alcoholic fermentation for the extraction of glycerin, the liquors are neutralized with lime or chalk, filtered, and boiled with ferric chloride, preferably under pressure, until the liquor no longer reacts with Fehling's solution. The iron is precipitated by lime, and then the lime by carbonic acid or sodium carbonate, the resulting liquor being filtered, concentrated, and distilled. In a modification, ferric sulphate is used instead of ferric chloride, the iron being in this case precipitated by baryta instead of lime.

PURIFICATION OF MOLASSES FOR FOOD *H. C. Cutler*, of Salt Lake City, U.S.A. 169,113 (31,540). November 8th, 1920.

Molasses is purified for use as food by the addition of an hydrolysing agent, for example from 0.25 to 10 per cent. of hydrochloric acid, whereby from 5 to 60 per cent. of the sugar is inverted. The liquid is dialyzed to remove inorganic salts, and boiled in open vessels to remove volatile impurities and coagulate albuminoids, the water content being maintained at about 80 per cent. during boiling. After removal of the albuminoids by filtration, the liquid is evaporated under reduced pressure until the water content is less than 25 per cent.

¹ I.S.J., 1920, 658.

² Also U.S. Patent, 1,387,380.

Patents.

MANUFACTURE OF "FONDANT" AND SIMILAR CHOCOLATES. *F. G. Fryer, B. G. McLellan, and Rowntree & Co., Ltd., of York.* 169,218 (15,575). June 9th, 1920.

In the manufacture of "fondant" and similar chocolates, the solid particles of the cocoa liquor and the sugar are ground before mixing to a degree of fineness such that at least 90 per cent. and preferably 95 per cent. pass a sieve having 240 meshes to the inch, the holes being very nearly 53/1000 mm. square; the mixed ingredients, which may include flavourings and cocoa butter, are subsequently passed through a grinding machine and brought to the degree of fineness desired in the final product, in which at least 98 per cent. pass the same sieve.

PRODUCTION OF DECOLORIZING CARBON FROM SULPHITE CELLULOSE WASTE LIQUOR. *R. Adler, of Carlsbad, (Czecho-Slovakia.* 165,788 (17,771). June 29th, 1921; convention date, July 5th, 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

Sulphite cellulose waste liquor, or the residue from the sulphite alcohol-process, is treated for the production of decolorizing carbon by precipitating the organic matter by the addition of neutral salts, such as potassium or sodium chloride, or alkaline earth hydrates; separating the precipitate by filtration; adding alkali compounds such as hydrates, carbonates, phosphates, sulphates, etc., to convert the organic matter into a soluble form; then carbonizing it, and removing the contained alkali salts by water, carbon dioxide being passed into the mixture in order to convert the sulphides present into carbonates for re-use in the process.

SULPHITATION OF SYRUPS (MOLASSES) IN THE MANUFACTURE OF (BEET) SUGAR. *M. von Wierusz-Kowalski, of Leipzig, Germany.* 137,849 (1247). January 14th, 1920.

Sulphitation of the comparatively pure syrup or thick-juice cannot be pushed far enough (it is said) on account of their purity owing to the danger of inversion. Although there are a whole series of substances by which an intense sulphitation may be made possible without incurring inversion,¹ yet the non-sugar substances which occur naturally in the beet may have the same inhibitive effect. Therefore, this inventor proposes a *modus operandi* "which consists in a crystallization and removal of part of the sugar for the purpose of reducing the quotient of purity and the subsequent sulphurization of the mother-liquor thus obtained, which on account of the reduction of purity can be pushed to a fairly high degree of acidity"

DRIVING CENTRIFUGAL MACHINES HAVING MECHANICAL UNLOADERS. *Wilfred Hunt (S. S. Hepworth Co., of New York, U.S.A.)* 162,920 (15,599). May 12th, 1921. (One drawing.)

AUSTRALIAN COMMONWEALTH.

CANE PLANTER.² *Adam McNichol, of Homebush Road, Mackay, Queensland.* 17,611 (of 1915.) October 17th, 1916.

Claim 4 :—"A box or hopper, a beam or frame, a divided axle each half of which is cranked and capable of being moved radially and transversely, a controlling lever and notched quadrant, and road wheels, in combination with a shoot, a double mould-board plough, and a small mould-board adjustably carried, as and for the purposes herein set forth and as illustrated in the accompanying drawings. . . ."

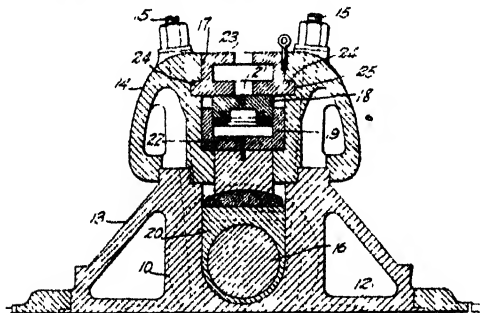
¹ See British Patent 2642 of 1902, in which it is proposed to use mono- or poly-valent phenols, which are recovered ultimately by steam-distillation.

² Advantages of this planter are stated to be :— It drills, plants and covers in one journey, and easily and rapidly; it carries plants for 20 chains (440 yds.); it can be kept level by two levers working independently of one another; and one man and one boy can plant four acres per day.

UNITED STATES.

CAP CONSTRUCTION FOR MILLS. *Godfrey Engel, Sr.*, of Brooklyn, New York.
1,333,539. July 5th, 1921. (Three figures.)

In this invention the housing is so constructed that the crane or lifting tackle may be directly applied to the pressure device, and also so that the pressure device may be directly lifted out of the top of the housing. In the figure 10 is the pressure roll, co-operating in the usual way with two lower rolls (not shown), journaled in a suitable



housing 13, which is provided with a separately formed cap piece 14, held in place by the tie-bolts 15. This cap is constructed in the present disclosure with an opening 17 in the top thereof of sufficient size to permit the removal of the pressure device. The pressure device shown is of the conventional type embodying a piston 18 and a cylinder 19 arranged to exert pressure upon the bearing member 20 of the pressure roll. Means are pro-

vided whereby the lifting tackle may be readily applied to the parts of the pressure device, viz., screw seats 21 and 22 to take suitable lifting devices, such as eye-bolts or the like. The pressure device is held seated in operative position in the housing by a locking plate or bar 23, serving both as a closure for the opening in the housing and as a thrust member for taking the upward thrust of the pressure device. This so-called "locking plate" is shown as removably secured in position by means of the integrally formed outstanding keys 24, which slide in corresponding keyways 25 formed in the opposite side walls of the opening or seat 17. With this construction, when it is desired at any time to remove one of the pressure devices, it is simply necessary to slide out the locking plate in a plane substantially parallel to the axis of the roll, and then by attaching the lifting gear to the parts of the pressure device, lift them directly out through the top of the housing. The locking plate is made of sufficient strength to take the thrust of the pressure device; and the tie-bolts at opposite sides of the opening in the cap piece firmly brace the same and overcome any spreading tendency.

DISTILLATION OF ALCOHOL FOR THE PREPARATION OF MOTOR FUEL. *Elbridge W. Stevens* (assignor to the *Chemical Fuel Co. of America, Inc.*, of Louisville, Ky., U.S.A.). 1,372,465. March 22nd, 1921.

Claim is made for: The process of fitting commercial water containing alcohol for use in making composite motor fuel, which comprises re-distilling such alcohol with a hydrocarbon oil and fusel oil and segregating a fraction substantially free of water and consisting mainly of alcohol. In an example given, the mixture which was distilled consisted of alcohol (92-94 per cent.), 40 parts; commercial fusel oil, 0.25 part; and benzol (gasolene or kerosene or tar oils) 60 parts; while the composition of the distillate was alcohol, 89.5 per cent.; benzol, 10 per cent.; and water, only 0.38 per cent. Ether to the amount of 5 per cent. may be added to this distillate to facilitate ignition.

CONTINUOUS THICKENING PROCESS. *A. L. Genter* (assignor to the *General Engineering Co.*, of Salt Lake City, Utah, U.S.A.). 1,379,095. May 24th, 1921.

Claim 1: A continuous thickening process consisting essentially in submerging a series of hollow filter elements in the mixture being thickened in a common reservoir, continuously removing filtrate from any desired portion of said filtering elements, and simultaneously producing a cleansing action on any desired portion of the said filtering elements.

Patents.

JAPAN.

PREPARATION OF CRYSTALLINE SUGAR FROM HONEY.¹ *N. Tuwaya*. 36,201. April 15th, 1920.

A dilute solution of honey is mixed with animal charcoal, filtered, and concentrated above its solidifying point by evaporating *in vacuo* at a low temperature. The syrup is vigorously agitated while hot, saturated with air, mixed with 3.6 per cent. of water, and set aside at a temperature below 10°C.

MANUFACTURE OF WHITE SUGAR.² *S. Tanaka*. 36,289. May 3rd, 1920.

Crude sugar solutions are mixed with 1-2.5 per cent. of milk-of-lime, neutralized with phosphoric acid or its acidic salts until a slightly alkaline reaction is obtained, heated at 90-95°C., filtered, cooled below 60°C., neutralized with sulphurous acid with phenolphthalein as indicator, filtered, bleached with 0.05 per cent. of sulphurous acid, and the resulting clarified liquid crystallized by the usual method.

Brief Summary of the Patents and Designs Act, 1919.³

Extension of patent right.—The period of monopoly is extended from 14 to 16 years; and provisional protection of inventions is increased to nine months, instead of six as hitherto. The grant in both cases is retrospective.

Renewal fees reduced one-half.—A patentee is entitled to have his patent endorsed with the words "licences of right," by which anyone may obtain a licence to work the patent on terms to be mutually agreed, or failing agreement, to be settled by the Comptroller of the Patent Office. The immediate effect is an abatement of one-half of the patent renewal fees. This will be a boon to many who have ideas for useful inventions, but no commercial facilities to work them when patented.

British subjects and other patentees, except late enemy subjects, may get an extension of the term of their patents beyond 16 years on application to the Court by an originating summons, which is less costly than by petition. It is only required to show that, by reason of the hostilities, they suffered loss or damage, and the Court, in deciding, may have regard solely to the loss or damage so suffered by the patentee.

Another important provision of the new Act is that if the Court, in any action for infringement of a patent, finds that any one or more of the claims in the specification, in respect of which infringement is alleged, are valid it shall grant relief in respect of any such claims which are infringed, without regard to the invalidity of any other claim in the specification. Hitherto, if one claim were proved to be bad the patent was bad.

The grounds of opposition have been enlarged. A patent of addition may become an independent patent if the original should be revoked. On application being made by any person in the prescribed form, the Comptroller may disclose the result of a search on any particular application for the grant of a patent. This will assist research work.

Designs which hitherto have been required to be new and original, are now registered if either new or original. This will enable many novelties to be protected which are not absolutely original, but variations of old shapes or patterns. A patent or registration of a design shall have to all intents the like effect as against His Majesty the King as it has against his subjects.

¹ From *Chem. Abs.*, 1921, 15, No. 9, 1418.

² From *Chem. Abs.*, 1921, 15, No. 10, 1688.

³ For this summary we are indebted to Messrs. REGINALD W. BARKER & CO., British and Foreign Patent and Trade Mark Agent, 56, Ludgate Hill, London, E.C.4.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING NOVEMBER 30TH.		ELEVEN MONTHS ENDING NOVEMBER 30TH.	
	1920. Tons.	1921. Tons.	1920. Tons.	1921. Tons.
UNREFINED SUGARS.				
Germany	2	....	5,832	....
Netherlands .....	....	....	....	398
Belgium .....	....	2,955	....	3,257
France .....	....	....	....	....
Czecho-Slovakia .....	....	....	....	....
Java	89,166	1,201	251,932	26,070
Philippine Islands	1	....	1	....
Cuba	1	24	516,477	214,097
Dutch Guiana .....	....	373	68	1,622
Hayti and San Domingo ..	....	....	13	88
Mexico .....	....	....	....	....
Peru	2,512	853	38,297	67,876
Brazil	1,725	13,044	7,763	67,695
Mauritius	20,333	440	122,152	183,820
British India	6	....	16,277	1,466
Straits Settlements .....	....	....	....	....
British West Indies, British Guiana & British Honduras	1,083	6,561	123,336	103,548
Other Countries	3,084	13,054	36,687	55,337
Total Raw Sugars	117,912	38,505	1,118,826	725,276
REFINED SUGARS.				
Germany .....	....	....	126	1
Netherlands	1	7,174	1,065	86,588
Belgium	2	16,328	2,058	36,312
France .....	....	....	294	3,058
Czecho-Slovakia .....	....	....	102	138
Java	1	1,100	5,013	4,340
United States of America ..	14	4,708	102,268	173,561
Argentine Republic .....	....	....	....	....
Mauritius .....	....	....	....	....
Other Countries	82	12,251	8,805	140,983
Total Refined Sugars ..	101	41,562	119,721	444,981
Molasses	1,451	10,471	67,553	87,214
Total Imports	119,464	90,538	1,308,100	1,257,471

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
BRITISH REFINED SUGARS.				
Denmark .....	....	..17	....	18
Netherlands	451	244	561	2,022
Portugal, Azores, and Madeira	....	....	....	....
Channel Islands	109	84	900	1,281
Canada .....	....	....	....	....
Other Countries	313	465	547	2,909
FOREIGN & COLONIAL SUGARS.	874	811	2,008	6,231
Refined and Candy	3,592	97	6,442	463
Unrefined	263	339	9,868	2,968
Various Mixed in Bond .....	....	....	....	....
Molasses	514	32	3,731	549
Total Exports	5,243	1,279	22,049	10,211

Weights calculated to the nearest ton.

United States.

(Wallett & Gray.)

	(Tons of 2,240 lbs.)	1921. Tons.	1920 Tons.
Total Receipts January 1st to December 1st ..		2,381,908 ..	2,826,819
Deliveries		2,389,618 ..	2,822,714
Meltings by Refiners		2,360,194 ..	2,390,887
Exports of Refined		373,000 ..	325,000
Importers' Stocks, December 1st		3,342 ..	4,105
Total Stocks, December 1st		61,623 ..	69,251
		1920.	1919.
Total Consumption for twelve months		4,084,672 ..	4,067,671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

	(Tons of 2,240 lbs.)	1918-19 Tons.	1919-20. Tons.	1920-21. Tons.
Exports		3,538,536 ..	3,261,271 ..	2,104,224
Stocks		284,152 ..	293,674 ..	1,152,222
		3,822,688	3,544,945	3,256,446
Local Consumption		82,000 ..	79,700 ..	105,000
Receipts at Ports to October 31st		3,904,688	3,624,645	3,361,446

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR ELEVEN MONTHS ENDING NOVEMBER 30TH, 1913, 1920, AND 1921.

	IMPORTS			EXPORTS (Foreign)		
	1913 Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921 Tons.
Refined	811,196 ..	119,731 ..	444,981	736 ..	6,442 ..	463
Raw	939,658	1,118,826	725,276	3,660 ..	9,868 ..	2,968
Molasses	143,910	67,553	87,214	340 ..	3,731 ..	549
	1,894,764	1,306,100	1,257,471	4,736	20,041	3,980
				HOME CONSUMPTION.		
			1913. Tons.	1920. Tons.	1921. Tons.	
Refined			799,203	143,703 ..	437,821	
Refined (in Bond) in the United Kingdom			665,537	727,953 ..	724,877	
Raw			107,304	168,661 ..	119,533	
Molasses			29,220	26,342 ..	10,468	
Molasses, manufactured (in Bond) in United Kingdom ..			34,480	64,727 ..	43,487	
Total			1,635,734	1,131,386	1,336,186	
Less Exports of British Refined			21,713	2,008	6,231	
			1,614,021	1,129,378	1,329,955	

Sugar Market Report.

Our last report was dated 10th November, 1921.

The active trading conditions last reported have given place to dulness and apathy on the part of buyers, who have been rendered nervous of the future by cheap offerings of forward deliveries of home Refined and American Granulated. Dealers seem to follow a general policy of reducing their stocks of near sugars, so freely entered into a few weeks ago, making the disposal of current offers a tedious business, although there is an absence of pressure of available lots from any quarter. Belgium has been obtaining good prices from France for crystals and other descriptions, and factories are holding for prices above the parity of this market, but good marks are obtainable from second-hands at 19s. 1½d. per cwt. for prompt delivery f.o.b. Antwerp, and 45s. 6d. per cwt. spot duty paid. Czechoslovakian sugars are momentarily withdrawn, owing to the difficulty of getting parcels down to Hamburg, firstly on account of the extreme congestion on the railways following the mobilization of a month ago, and secondly on account of ice in the River Elbe delaying progress of the barges. Nominally superior marks such as SCH, TTDA, etc., value 19s. 9d.—19s. 6d., Cubes 24s. 3d.—24s. December f.o.b. Hamburg. Tates' London Granulated is quoted 48s. 9d. prompt, 46s. 6d. January/March; No. 1 Cubes 54s. 6d. spot duty paid. American Granulated has been persistently pressed upon this market for early 1922 deliveries at prices from 20s. down to 18s. 9d. c.i.f. U.K. ports for January/March; this has made the running for values, apparently without resulting in any sales of importance, whilst British refiners have countered every decline by a competitive reduction.

Since the determination of the trade to await further developments before entering into any forward contracts has robbed these operations of success so far as actual selling is concerned, it would seem that one must seek elsewhere for the underlying cause of the pressure. The Cuban stock has been the bugbear of the market for many months past, and the time is near when necessity will drive this question to some sort of solution. Already the Cuban Senate has consented to the dissolution of the Selling Committee at the end of the current year, which probably brings the settlement no nearer, but tends rather to force the pace in the invention of expedients for getting rid of the stocks; the more so as actual grinding of the new crop has commenced. It might easily be that the offerings of granulated to the U.K. are made by America as a depressing manoeuvre, with an eye to securing a good round quantity of Cuban 96's at a rock-bottom price. In the meantime negotiations are on foot for 900,000 tons of old crop Cubans to be taken by the American refiners for refining on "toll" over the period to August next. Whether the Cuban holders would fall in with such a proposal in face of the difficulties attending such an extended operation, is problematical. Rumours of other schemes are being constantly circulated.

Cuban Centrifugals are to-day offered at 12s. 6d. per cwt. c.i.f. U.K. ports, and Peruvians at the same price. Business is reported in Brazil 80's at 9s. 6d. c.i.f. U.K. floating.

The Java market developed a firm tone under the influence of activity in new crop deliveries; early shipments of Whites were taken by merchants and speculators at 12 guilders per picul, first cost, Browns at 11-00 and Muscovados at 10-75 guilders. Prices for old crop were advanced in sympathy to about 13 guilders f.o.b., but values have reacted on the quietness of the demand from India and the easy tendency of markets generally. There are sellers of new crop now at 11-50 guilders for Whites and 10-50 guilders for Browns. Whites cost and freight Calcutta are quoted by Java sellers to-day at 18s. 9d. December and January/March shipment, whilst second hands are willing to sell December at 17s. 9d.

Total shipments from Java to end of October were approximately 1,000,000 tons, leaving a balance of about 585,000 tons still to be shipped over the balance of the campaign, say to end of April next.

Total sales to date by the Mauritius Syndicate are about 70,000 tons, in respect of which it is said that freight engagements have been entered for some 50,000 tons this way, although this latter quantity has by no means been disposed of by holders. Last business reported was at 19s. 1½d. per cwt. c.i.f. U.K., which price is no longer obtainable.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
December 9th, 1921.

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